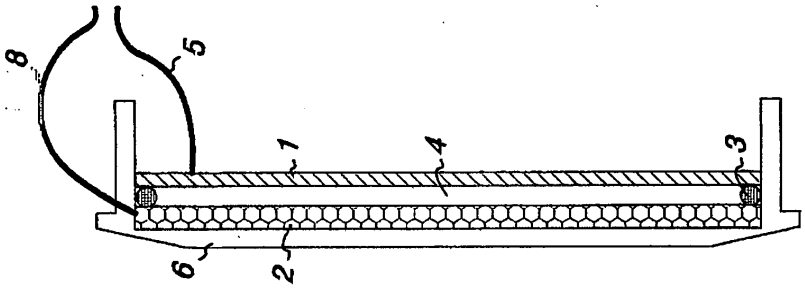


Fig. 1B

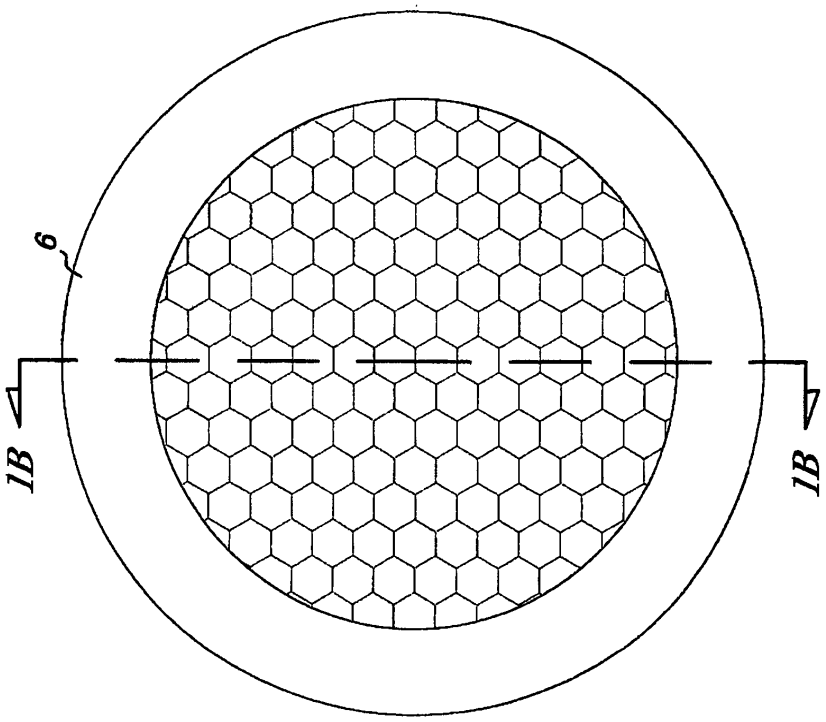


Fig. 1A

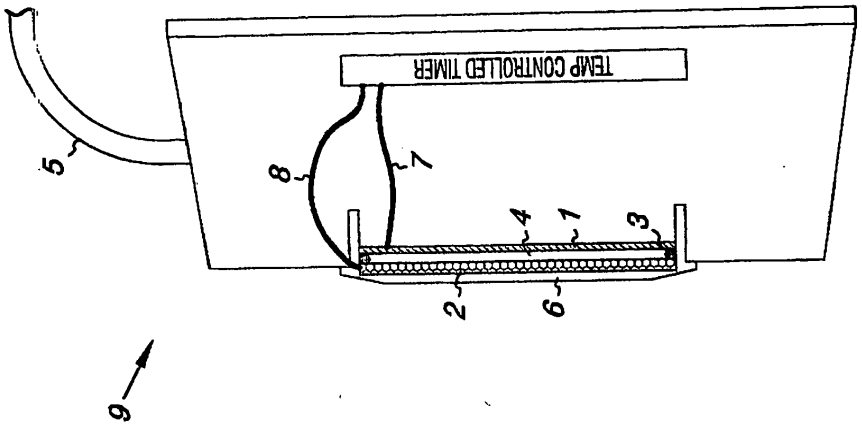


Fig. 2B

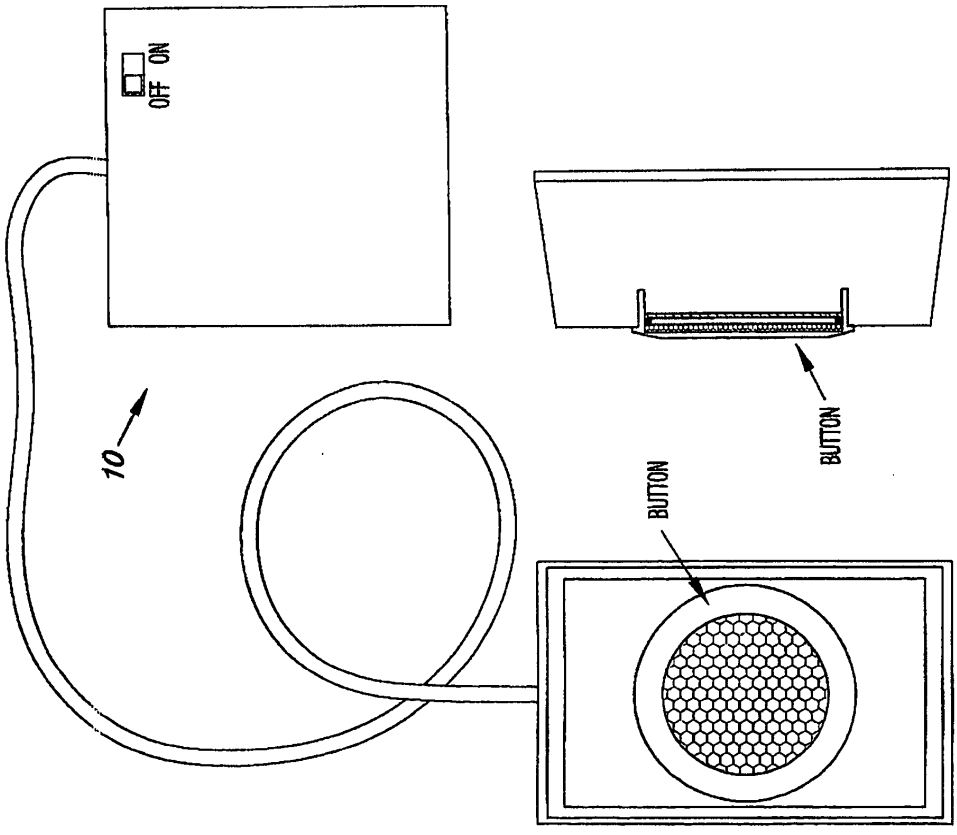
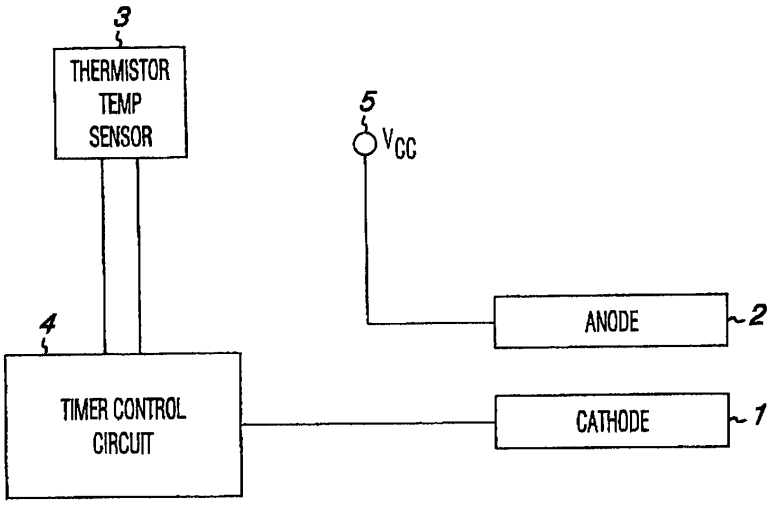


Fig. 2A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SENSOR
5
V_{CC}
4
TIMER CONTROL
CIRCUIT
ANODE
2
CATHODE
1

Fig. 3

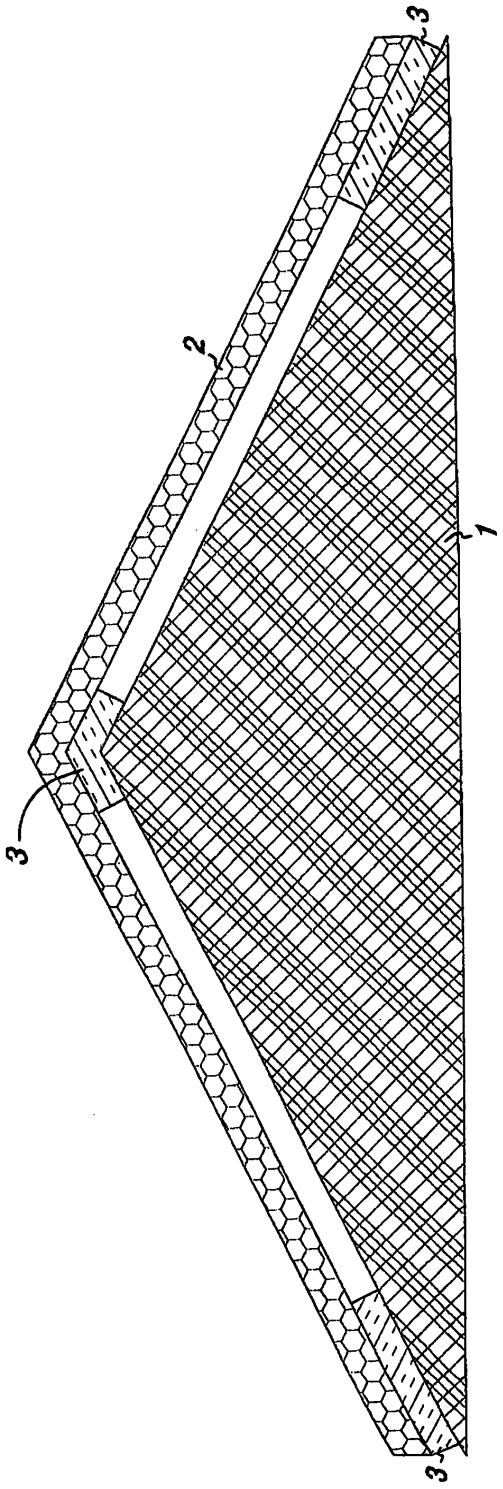


Fig. 4

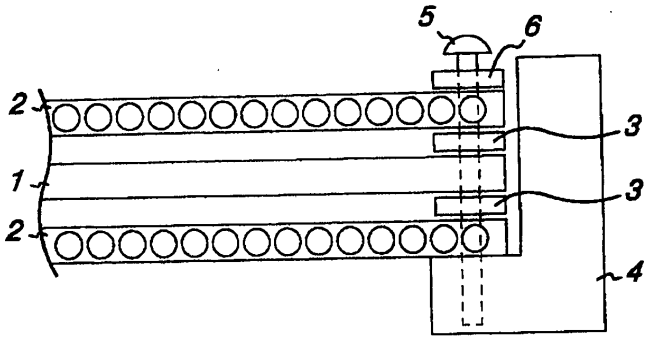


Fig. 5A

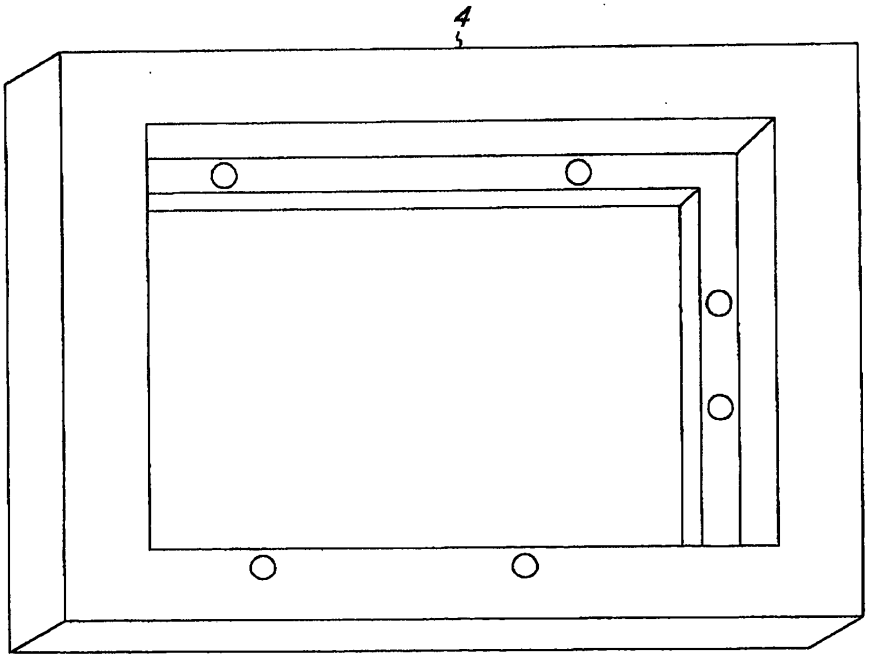
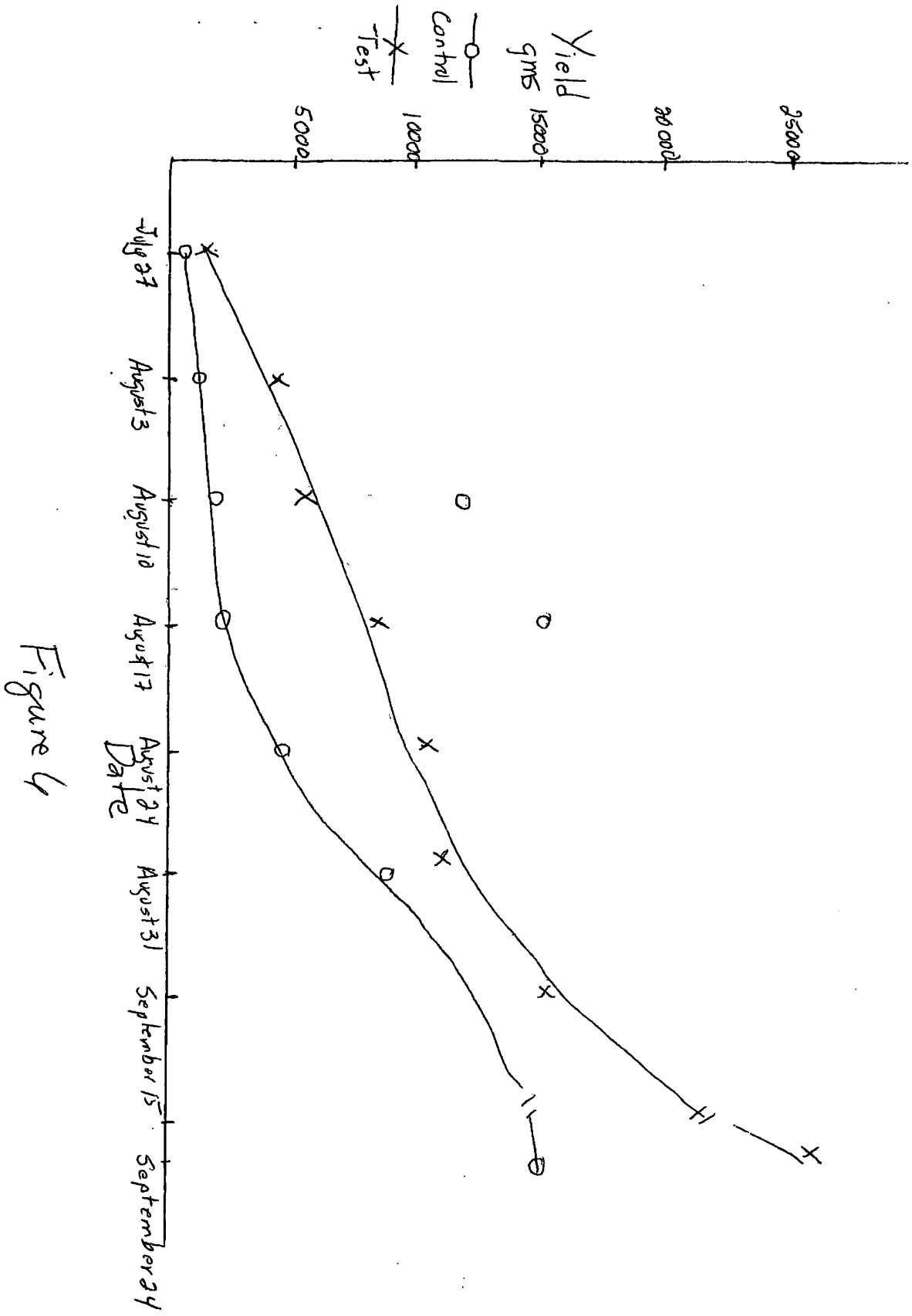


Fig. 5B


Yield gms
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Test
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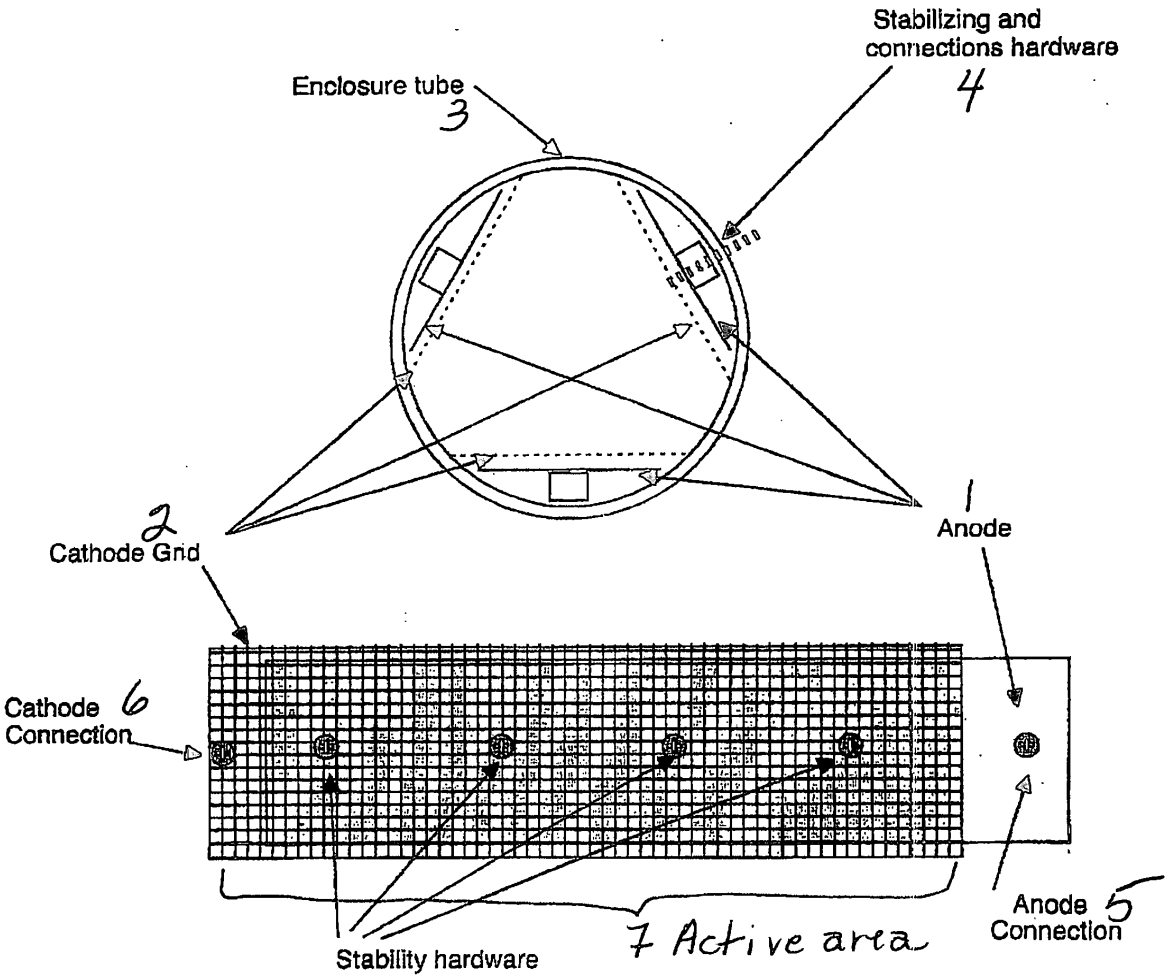
10000
15000
20000
25000
July 27
August 3
August 10
August 17
August 24
August 31
September 7
September 14
Date

Figure 4

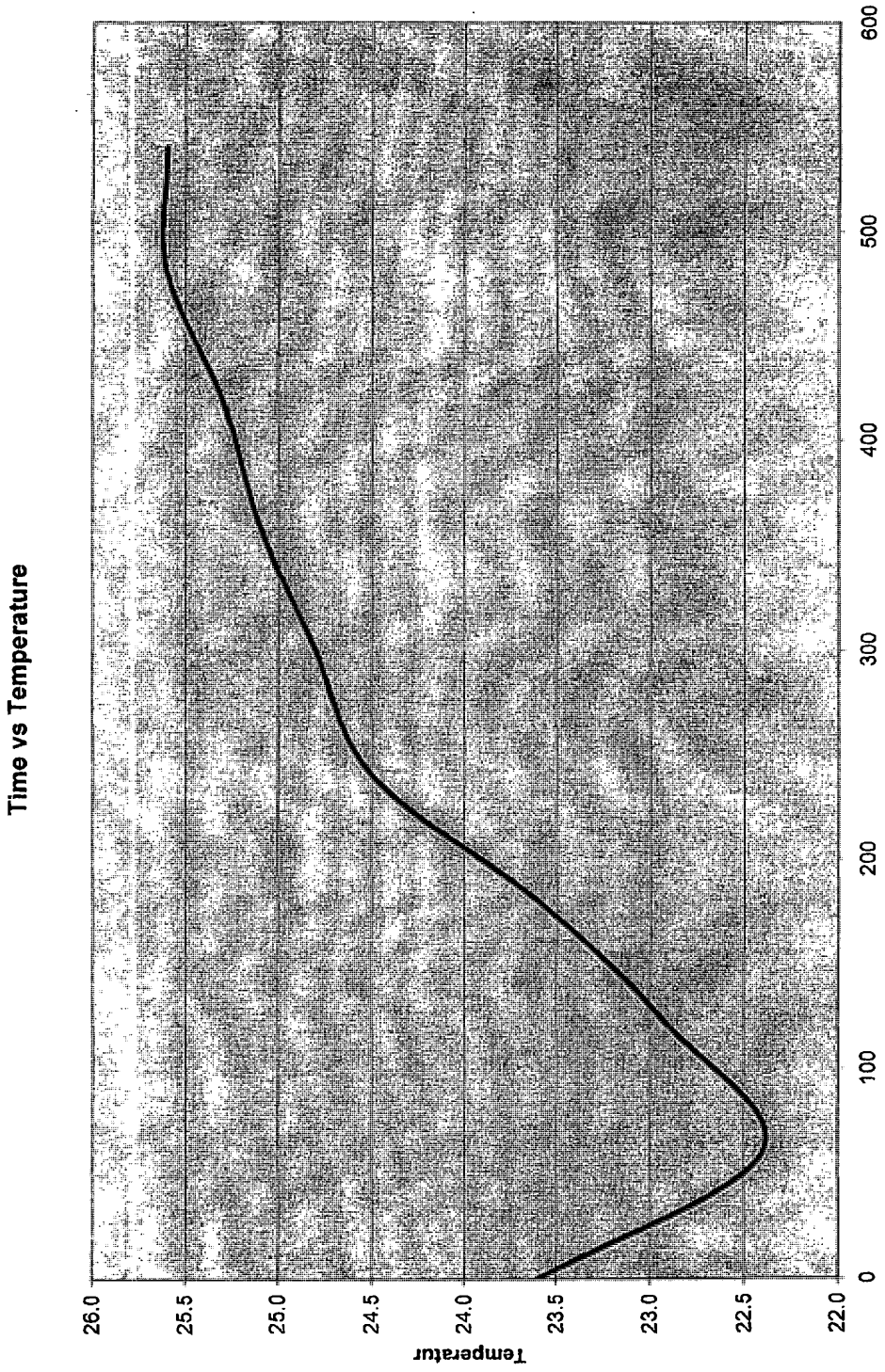
3 Element Flow Through Oxygenation Chamber



Depending on requirements tube can contain 1 2 3 4 or more elements.

Figure 7

CONFIDENTIAL



BEST AVAILABLE COPY

Figure 8

CONFIDENTIAL

UNITED STATES PATENT APPLICATION

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name:

I verily believe that I am the original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: **FLOW-THROUGH OXYGENATOR** the specification for which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with 37 C.F.R § 1.56. I also acknowledge my duty to disclose all information known to be material to patentability which became available between a filing date of a prior application and the national or PCT filing date in the event this is a Continuation-in-Part application in accordance with 37 C.F.R. § 1.63(e).

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below:

Application Number	**Filing Date**
60/431,577	02/22/2002

I hereby claim the benefit under 37 C. F.R. § 1.63(E) of any United States provisional application(s) listed below:

Application Number	**Filing Date**
10/372,017	02/21/2003

I hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith:

Terry, Kathleen R.	Reg.No. 31884
McTavish, Hugh	Reg. No. 48341

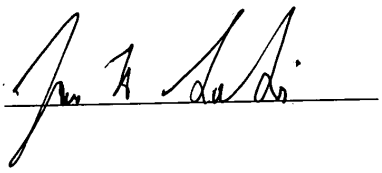
Please direct all correspondence in this case to: Kathleen R. Terry
2417 Como Avenue
St. Paul, MN 55108-1459
651-659-9819
Krterry@visi.com
FAX 651 603 1809

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application issued thereon.

Full name of sole inventor number:

Citizenship: United States of America

Residence Address: James Andrew Senkiw
4750 Aldrich Avenue North
Minneapolis, MN 55430-3529

Signature:  Date: 12/5/03

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2003

Application or Docket Number: 10732326

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	8	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	8 minus 20=	*
INDEPENDENT CLAIMS	2 minus 3 =	*
MULTIPLE DEPENDENT CLAIM PRESENT	☐	

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	385.00	OR	BASIC FEE	770.00
XS 9=		OR	XS18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL	385	OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
XS 9=		OR	XS18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

1 6

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875 (Rev 10/03) Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

12/12/2003 SZEWDIE1 00000033 10732326
01 FC:2001 385.00 OP

PTO-1556
(5/87)

*U.S. Government Printing Office: 2002 — 489-267/69033

PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
Stylesheet Version v1.2

EPAS ID: PAT3803298

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	LIEN

CONVEYING PARTY DATA

Name	Execution Date
OXYGENATOR WATER TECHNOLOGIES, INC.	03/13/2016

RECEIVING PARTY DATA

Name:	SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
Street Address:	1600 TCF TOWER
Internal Address:	121 SOUTH 8TH STREET
City:	MINNEAPOLIS
State/Country:	MINNESOTA
Postal Code:	55402

PROPERTY NUMBERS Total: 4

Property Type	Number
Application Number:	12023431
Application Number:	14601340
Application Number:	13247241
Application Number:	13657311

CORRESPONDENCE DATA

Fax Number: (612)642-8407

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: 612-672-8200
Email: debra.dix@maslon.com
Correspondent Name: AMY SWEDBERG
Address Line 1: 90 SOUTH 7TH STREET STE 3300
Address Line 2: MASLON LLP
Address Line 4: MINNEAPOLIS, MINNESOTA 55402

ATTORNEY DOCKET NUMBER:	2010-0164
NAME OF SUBMITTER:	STEVEN W. LUNDBERG
SIGNATURE:	/Steven W. Lundberg/
DATE SIGNED:	03/28/2016
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 2
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NOTICE OF ATTORNEYS' LIEN IN PATENTS

NOTICE IS HEREBY GIVEN that the law firm of Schwegman, Lundberg & Woessner, P.A. ("Law Firm"), with its principal place of business at 1600 TCF Tower, 121 South Eighth Street, Minneapolis, Minnesota, duly authorized to practice as such in the State of Minnesota, claims and holds a lien in and to all of the patents listed on Exhibit A, and all of the applications and registrations associated therewith, together with all proceeds thereof, of Oxygenator Water Technologies, Inc., a Minnesota corporation ("Client"), with its registered address at 1660 S Hwy 100 #598, St Louis Park, MN 55416. Said lien is claimed for legal services rendered by Law Firm to Client for representation of Client in proceedings involving and affecting the ownership and title to the property upon which this lien is claimed for the reasonable and agreed upon value of $257,609.80 of which the sum of $43,977.30 remains unpaid.

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.

Steven W. Lundberg
Shareholder

STATE OF MINNESOTA)
) ss.
COUNTY OF HENNEPIN)

On this 23rd day of March, 2016, before me personally came Steven W. Lundberg, who being duly sworn did depose and say that he is a shareholder of the Law Firm described in and which executed the foregoing instrument.

THERESA A. HATHAWAY
NOTARY PUBLIC - MINNESOTA
My Commission Expires
January 31, 2018

Theresa A. Hathaway
NOTARY PUBLIC

Exhibit A

SLW FILE NUMBER	MATTER TYPE	TITLE	COUNTRY	APPLICATION NUMBER	FILING DATE	STATUS	PATENT NUMBER	ISSUE DATE	PRIORITY DATE	PUBLICATION NUMBER	INVENTORS
3406.002US1	Utility - DIV	FLOW-THROUGH OXYGEN	United States of America	12/023,431	Jan 31, 2008	Issued	7,670,495	Mar 2, 2010	Feb 22, 2002	US 2008-0179259 A1	James Andrew Senkiw
3406.005US2	Utility - REIS	FLOW-THROUGH OXYGEN	United States of America	14/601,340	Jan 21, 2015	Transferred			Sep 28, 2011		James Andrew Senkiw
3406.005USR	Utility - REIS	FLOW-THROUGH OXYGEN	United States of America	13/247,241	Sep 28, 2011	Issued	RE45,415	Mar 17, 2015			James Andrew Senkiw
3406.006US1	Utility - NPREG	ENHANCED RESIN REGEN	United States of America	13/657,311	Oct 22, 2012	Pending			Oct 24, 2011	US-2013-0098819-A1	Mark Rolfes

PATENT ASSIGNMENT

Electronic Version v1.1
Stylesheet Version v1.1

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	LICENSE

CONVEYING PARTY DATA

Name	Execution Date
Oxygenator Water Technologies, Inc.	10/04/2012
Aqua Innovations Incorporated	10/04/2012

RECEIVING PARTY DATA

Name:	Roy H Lecy
Street Address:	2640 North Saunders Lake Drive
City:	Minnetrista
State/Country:	MINNESOTA
Postal Code:	55364

PROPERTY NUMBERS Total: 3

Property Type	Number
Patent Number:	6689262
Patent Number:	7396441
Patent Number:	7670495

CH $120.00 6689262

CORRESPONDENCE DATA

Fax Number: 6123376100
Correspondence will be sent via US Mail when the fax attempt is unsuccessful.
Phone: 6123376100
Email: nathanbrandenburg@siegelbrill.com
Correspondent Name: Nathan M. Brandenburg
Address Line 1: 100 Washington Avenue South
Address Line 2: Suite 1300
Address Line 4: Minneapolis, MINNESOTA 55401

ATTORNEY DOCKET NUMBER:	26141-001
NAME OF SUBMITTER:	Nathan M. Brandenburg

Signature:	/nathanmbrandenburg/
Date:	04/30/2013
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 35
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License Agreement

THIS AGREEMENT ("Agreement") is entered into this 30th day of July, 2008 (the "Effective Date"), by and between Oxygenator Water Technologies, Inc., a Minnesota corporation with offices at 6101 Baker Rd., #206, Minnetonka, Minnesota, 55435 ("Licensor") and Aqua Innovations, Inc. a Minnesota corporation with offices at 6101 Baker Rd., #206, Minnetonka, Minnesota, 55435 ("Licensee", and Licensor and Licensee each a "Party" and together the "Parties"). Initially capitalized terms defined in this Agreement shall have the meaning ascribed to them respectively herein.

WITNESSETH:

LICENSOR owns the technology for which patents have been issued and are pending with respect to electrolytic hydrolysis of water to increase its dissolved oxygen content. A more complete description of said technology, together with a description of the patents issued and currently pending for said technology, is set forth in Article 1 below and in Exhibit "A" attached hereto.

LICENSOR anticipates and intends that it will make additional discoveries and improvements to said technology, some of which may be patentable.

It is further anticipated by the parties that LICENSOR may make improvements to said technology and additional discoveries concerning other applications for said technology.

The parties desire that LICENSOR grant a perpetual, exclusive license to LICENSEE to develop and sell throughout the world certain products utilizing the technology LICENSOR has developed and may in the future develop, all according to the terms and conditions set forth in this Agreement.

The parties further desire that LICENSOR will retain the complete and entire right to develop and sell throughout the world in markets not licensed to LICENSEE hereunder products utilizing the technology LICENSOR has developed and may in the future develop or the technology that LICENSEE may develop in the future, also according to the terms and conditions set forth in this Agreement.

Thus, the parties have agreed to enter into a licensing arrangement by which each party will be entitled to benefit from the other party's patents, technology and know-how concerning electrolytic hydrolysis of water in the sale of products in certain markets.

NOW, THEREFORE, based on the foregoing and the mutual covenants and agreements herein contained, the parties hereby covenant and agree as follows:

EXHIBIT "B"

LICENSEE Markets

All worldwide markets for:

- Waste Water Treatment
- Medical Applications
- Sport Fishing
- Aqua Culture
- Horticulture (consumer and commercial)
- Hydroponics

Markets excluded from license agreement (including but not limited to):

- Water Treatment (all applications except waste water)
- Fermentation
- Desalination
- Human Nutrition
- Animal Nutrition

ARTICLE 1
DEFINITIONS

When used in this Agreement, the following terms have the meanings set forth below unless a different and common meaning of the term is clearly indicated by the context, and variants and derivatives of the following terms shall have correlative meanings:

"*Agreement*" has the meaning set forth in the preamble.

"***LICENSOR Documents"*** has the meaning set forth in Section 2.6.

"***LICENSOR Improvements***" means all developments LICENSOR may make in the LICENSOR Technology or the LICENSEE Technology prior to the termination of this Agreement, whether or not patentable, and which are invented, developed, discovered or otherwise acquired by LICENSOR and which LICENSOR may lawfully communicate to LICENSEE.

"***LICENSOR Markets***" means all uses for the LICENSOR Technology and the LICENSEE Technology other than in the LICENSEE Markets.

"***LICENSOR Patents***" means all of LICENSOR's patents (whether issued to LICENSOR or controlled by license rights or otherwise and whether such rights are held alone or jointly with others, and patents pending now, or during the term of this Agreement, issued to LICENSOR (by any country) relating to the LICENSOR Technology, including, but not limited to, those patents and those patents pending described on Exhibit A and any continuations, continuations-in-part, divisions, registrations, confirmations, reissues, renewals or extensions of term thereof.

"***LICENSOR Products***" means any product manufactured and/or sold or distributed by LICENSOR or a sub licensee of LICENSOR under any claim contained in the LICENSEE Patents.

"***LICENSOR Property***" means LICENSOR Patents, LICENSOR Improvements and LICENSOR Technology.

"***LICENSOR Technology***" means LICENSOR's unpatented technology and information now existing and relating to, and embodying LICENSOR's experience in electrolytic hydrolysis of water. LICENSOR Technology shall include the technical information in all current and future manuals, formulae, specifications, test data and procedures, flow charts, apparatus plans, drawings, designs and other information actually communicated by LICENSOR to LICENSEE during the term of this Agreement, whether contained in documentary form, electronic medium or communicated as a result of LICENSOR imparting the same directly or giving LICENSEE access to any of LICENSOR's production facilities.

"***Effective Date***" has the meaning set forth in the preamble.

"***LICENSEE Documents"*** has the meaning set forth in Section 2.7.

"***LICENSEE Improvements***" means all developments LICENSEE may make in the LICENSOR Technology or the LICENSEE Technology prior to the termination of this Agreement, whether or not patentable and which are invented, developed, discovered or otherwise acquired by LICENSEE and which LICENSEE may lawfully communicate to LICENSOR.

"***LICENSEE Markets***" means those markets for Licensee Products as are described in Exhibit B attached hereto.

"***LICENSEE Patents***" means all of LICENSEE's patents (whether issued to LICENSEE or controlled by license rights or otherwise and whether such rights are held alone or jointly with others) which may after the effective date of this Agreement be issued (by any country) relating to electrolytic hydrolysis of water and any continuations, continuations-in-part, divisions, registrations, confirmations, reissues, renewals or extensions of term thereof.

"***LICENSEE Products***" means any product manufactured and/or sold or distributed to any party other than LICENSOR by LICENSEE or a sublicense of LICENSEE in conformity with the terms of this Agreement, including, but not limited to, any product which is based on any claim or thing contained in any LICENSOR Property.

"***LICENSEE Property***" means LICENSEE Patents, LICENSEE Improvements and LICENSEE Technology.

"***LICENSEE Technology***" means LICENSEE's unpatented technology and information which LICENSEE may develop relating to, and embodying LICENSEE's experience in, the manufacturing, the processing, quality control, and sale of the LICENSEE Products. LICENSEE Technology shall include the technical information in all manuals, formulae, specifications, test data and procedures, flow charts, apparatus plans, drawings, designs and other information actually communicated by LICENSEE to LICENSOR during the term of this Agreement, whether contained in documentary form, electronic medium or communicated as a result of LICENSEE imparting the same directly or giving LICENSOR access to any of LICENSEE's production facilities.

"***Territory***" means the world.

ARTICLE 2
MARKETS AND LICENSING

2.1. Exclusive Markets. The parties agree that unless properly terminated by LICENSOR pursuant to Section 5.1 below, LICENSEE will have the exclusive right to exploit the LICENSOR Property and the LICENSEE Property in the manufacture, use and sale or other distribution of LICENSEE Products in the LICENSEE Markets in the Territory. The parties further agree that LICENSOR will have the exclusive right to exploit the LICENSOR Property and the LICENSEE Property in the manufacture, use and sale or other distribution of LICENSOR Products in the LICENSOR Markets in the Territory. LICENSEE may not, directly or indirectly, distribute in any manner any product which competes with the LICENSEE Products in any manner nor may LICENSEE assist or have any interest in any third party distributing any such products through licensing or assignment of technology to any such third party or by any other means.

2.2. Exclusive License to LICENSEE. Subject to the terms and conditions of this Agreement, LICENSOR hereby confers upon LICENSEE the sole and exclusive license, with the right of sublicense, under the LICENSOR Property, to make, have made, use and sell the LICENSEE Products in the LICENSEE Markets in the Territory and to prevent infringement of the LICENSOR Patents, and to prevent unauthorized use and disclosure of the LICENSOR Technology in connection therewith. No license is conferred hereby to make, have made, use and sell articles which are not LICENSEE Products.

2.3. Exclusive License to LICENSOR. Subject to the terms and conditions of this Agreement, LICENSEE hereby confers upon LICENSOR the sole and exclusive, royalty-free license, with the right of sublicense, under the LICENSEE Property, to make, have made, use and sell the LICENSOR Products in the LICENSOR Markets in the Territory and to prevent infringement of the LICENSEE Patents, and to prevent unauthorized use and disclosure of the LICENSEE Technology in connection therewith. No license is conferred hereby to make, have made, use and sell articles which are not LICENSOR Products.

2.4. Product Markings. The Parties shall insure that all LICENSOR Products and all LICENSEE Products are marked with any applicable patent number and all labeling and other product information shall be marked in such manner as to conform with the patent laws and practices of the country of sale.

2.5 Transfer of Technology by LICENSOR. As promptly as practicable after the execution of this Agreement, LICENSOR shall deliver to LICENSEE all information concerning the LICENSOR Property. LICENSOR also promptly shall deliver to LICENSEE all future information it acquires concerning the LICENSOR Property. All documentary information so delivered or any documentary information following non-documentary disclosure by LICENSOR, shall be referred to as "LICENSOR Documents". LICENSEE shall receive, use, maintain, restrict access to or copying of, and safeguard the LICENSOR Documents in such manner as to maximize the value of the LICENSOR Patents, the LICENSOR Technology and the LICENSOR Improvements; without limiting the generality of the foregoing, LICENSEE shall, and shall cause its employees and

representatives to, use reasonable care to prevent unauthorized access to, copying, use, publication, disclosure or other dissemination of the LICENSOR Documents. Upon 10 days advance notice and at reasonable times, LICENSOR shall permit LICENSEE access to its technical personnel at its offices or at such locations as is mutually agreed upon by the Parties. During such visits, technically competent personnel will be provided by LICENSOR to answer fully such questions as LICENSEE may have with a view to transferring the LICENSOR Property. Nothing in this Section 2.6 shall require LICENSOR to disclose to LICENSEE any technological information which it does not own or that is otherwise subject to restrictions on use or disclosure.

2.6. Transfer of Technology by LICENSEE. As promptly as practicable after LICENSEE develops, discovers or otherwise comes into possession of LICENSEE Patents, LICENSEE Improvements and/or LICENSEE Technology, LICENSEE shall deliver to LICENSOR all information concerning same. All documentary information so delivered or any documentary information following non-documentary disclosure by LICENSEE, shall be referred to as "LICENSEE Documents." LICENSOR shall receive, use, maintain, restrict access to or copying of, and safeguard the LICENSEE Documents in such manner as to maximize the value of the LICENSEE Patents, the LICENSEE Technology and the LICENSEE Improvements; without limiting the generality of the foregoing, LICENSOR shall, and shall cause its employees and representatives to, use reasonable care to prevent unauthorized access to, copying, use, publication, disclosure or other dissemination of the LICENSEE Documents. Upon 10 days advance notice and at reasonable times, LICENSEE shall permit LICENSOR access to its technical personnel at its offices or at such locations as is mutually agreed upon by the Parties. During such visits, technically competent personnel will be provided by LICENSEE to answer fully such questions as LICENSOR may have with a view to transferring to LICENSOR the LICENSEE Property. Nothing in this Section 2.7 shall require LICENSEE to disclose to LICENSOR any technological information which it does not own or that is otherwise subject to restrictions on use or disclosure.

2.7. Further Prosecution of Patents. LICENSOR will continue with the prompt prosecution of all pending patent applications filed by LICENSOR as detailed on Schedule "A", so long as it is commercially reasonable to do so, and LICENSOR will periodically advise LICENSEE of the status of such prosecutions. As soon as practical, the Parties will confer to determine the countries for which the Parties desire protection for the LICENSOR Patents. In the event that LICENSEE files an application for a patent(s) covering electrolytic hydrolysis of water, LICENSEE will periodically advise LICENSOR of the status of the prosecution of any such patent. As soon as practical after any such application by LICENSEE, the Parties will confer to determine the countries for which the Parties desire protection for the LICENSEE Patents. From the date of this Agreement, all expenses incurred in filing for and maintaining protection in those countries mutually agreed upon (other than expenses of prosecuting the original patent application in the first jurisdiction, which will be the responsibility of the Party filing the patent application) will be shared equally by the Parties. Either Party may seek protection in any country not mutually agreed upon by paying the full amount of the cost thereof. A party seeking such additional protection will receive the full cooperation of the other Party (other than in paying the expenses thereof) in protecting all patents in any such other country.

2.8. Additional Covenants. Each of LICENSOR and LICENSEE shall faithfully comply with their respective obligations under this Agreement and shall incorporate all terms and conditions required by this Agreement in any contracts with third parties to whom access to the LICENSOR Property or the LICENSEE Property, as the case may be, may (but only in accordance with this Agreement) be given. Each of LICENSOR and LICENSEE shall indemnify and hold harmless the other Party and its successors and assigns from any injury, loss, or damage of any kind or nature, or any other liability sought to be imposed on such Party, and arising out of or in connection with or resulting from the marketing, sale or use of the imdemnifying Party's product(s), including any advertising or other promotional activities related thereto.

2.9. Infringement Actions. Neither LICENSOR nor LICENSEE will have any responsibility to the other Party for any damage or expense incurred by such other Party which arises from any action, claim or cause of action brought by any person as the result of any alleged patent infringement or trade secret misappropriation by reason of such other Party's manufacture, use or sale of any product under any of the licenses conferred hereby.

2.10. LICENSEE's Rights in Event of Third Party Infringement. LICENSEE shall have the right, in LICENSOR's name (if required by law, otherwise, in LICENSEE's name) but at LICENSEE's sole expense, to sue third parties in the LICENSEE Markets for infringements of the LICENSOR Patents and misappropriation of the LICENSOR Technology and unpatented LICENSOR Improvements, and LICENSOR shall, but at LICENSEE's expense for LICENSOR's direct associated expenses, fully and promptly cooperate and assist LICENSEE in connection with any such suit. LICENSEE shall promptly reimburse LICENSOR for said suit-associated direct expenses upon presentation of LICENSOR's itemized statement therefor. LICENSOR may, if it so elects, join in any such suit as a plaintiff. All damages, awards or settlement proceeds in such suit shall be LICENSEE's. If LICENSEE, after notice from LICENSOR of an alleged infringement or misappropriation, shall within 90 days fail to institute suit, LICENSOR, in its own name (or, if required by law, in its and LICENSEE's name) and at its own expense, may sue therefore, and LICENSEE shall, but at LICENSOR's expense for LICENSEE's direct associated expenses, fully and promptly cooperate and assist LICENSOR in connection with any such suit. LICENSOR shall promptly reimburse LICENSEE for said suit-associated direct expenses upon presentation of LICENSEE's itemized statement therefor. All damages, awards or settlement proceeds in such suit shall be LICENSOR's.

2.11. LICENSOR's Rights in Event of Third Party Infringement. LICENSOR shall have the right, in LICENSEE's name (if required by law, otherwise, in LICENSOR's name) but at LICENSOR's sole expense, to sue third parties in the LICENSOR Markets for infringements of the LICENSEE Patents and misappropriation of the LICENSEE Technology and unpatented LICENSEE Improvements, and LICENSEE shall, but at LICENSOR's expense for LICENSEE's direct associated expenses, fully and promptly cooperate and assist LICENSOR in connection with any such suit. LICENSEE may, if it so elects, join in any such suit as a plaintiff. LICENSOR shall promptly reimburse LICENSEE for said suit-associated direct expenses upon presentation of LICENSEE's itemized

statement therefor. All damages, awards or settlement proceeds in such suit shall be LICENSOR's. If LICENSOR, after notice from LICENSEE of an alleged infringement or misappropriation, shall within 90 days fail to institute suit, LICENSEE, in its own name (or, if required by law, in its and LICENSOR's name) and at its own expense, may sue therefore, and LICENSOR shall, but at LICENSEE's expense for LICENSOR's direct associated expenses, fully and promptly cooperate and assist LICENSEE in connection with any such suit. LICENSEE shall promptly reimburse LICENSOR for said suit-associated direct expenses upon presentation of LICENSOR's itemized statement therefor. All damages, awards or settlement proceeds in such suit shall be LICENSEE's.

2.12. LICENSEE Royalty Payment. None. License is granted without cost to LICENSEE.

ARTICLE 3
INDEMNIFICATION

3.1. Indemnification by LICENSEE. LICENSEE shall indemnify and hold LICENSOR and its successors and assigns harmless from any injury, loss, or damage of any kind or nature, or any other liability sought to be imposed on LICENSOR arising out of or in connection with or resulting from the marketing, sale or use of the LICENSEE Products, including any advertising or other promotional activities related thereto. LICENSOR shall be an added insured party to LICENSEE's product liability insurance, which shall have coverage limits of at least two million dollars ($2,000,000) per incident and which LICENSEE shall procure and have in place no later than the date on which LICENSEE first makes a delivery of any of the LICENSEE Products. Such policy of insurance shall provide that it may not be cancelled unless LICENSOR is provided at least thirty (30) days advance written notice.

3.2. Indemnification by LICENSOR. LICENSOR shall indemnify and hold LICENSEE and its successors and assigns harmless from any injury, loss, or damage of any kind or nature, or any other liability sought to be imposed on LICENSEE arising out of or in connection with or resulting from the marketing, sale or use of the LICENSOR Products, including any advertising or other promotional activities related thereto. At such time, if any, as LICENSOR shall sell LICENSOR Products, LICENSOR shall add LICENSEE as an added insured party to LICENSOR's product liability insurance, which shall have coverage limits of at least two million dollars ($2,000,000) per incident and which LICENSOR shall procure and have in place no later than the date on which LICENSOR first makes a delivery of any of the LICENSOR Products. Such policy of insurance shall provide that it may not be cancelled unless LICENSEE is provided at least thirty (30) days advance written notice.

ARTICLE 4
CONFIDENTIALITY

4.1. Restrictions on Use and Disclosure of LICENSOR Property by LICENSEE. LICENSEE shall use the LICENSOR Property in confidence and shall not

disclose same to its employees to whom access may be given in accordance with this Agreement until each such employee shall have previously agreed not to disclose such information. Restrictions on use and disclosure of any portion thereof shall terminate: (a) if that portion is, or becomes, generally known within the related trade or industry through no default of LICENSEE, or (b) upon the expiration of the obligation of LICENSEE under this Agreement to pay royalties to LICENSOR.

4.2. Restrictions on Use and Disclosure of LICENSEE Property by LICENSOR. LICENSOR shall use the LICENSEE Property in confidence and shall not disclose same to its employees to whom access may be given in accordance with this Agreement until each such employee shall have previously agreed not to disclose such information. Restrictions on use and disclosure of any portion thereof shall terminate if that portion is, or becomes, generally known within the related trade or industry through no default of LICENSOR.

4.3. Employees; Third Parties Etc. In order to faithfully perform their respective obligations under sections 4.1 and 4.2, the Parties shall limit access to the other Party's Property to only those of its officers, employees and agents who shall have a need to receive or have access to that portion, and then only for the purposes of the practice under the licenses conferred by this Agreement. Each Party will require any third party, to whom access may be authorized under this Agreement, to execute an appropriate confidentiality agreement.

4.4. Authorized Required Disclosures. Nothing in this Article 4 shall prevent a Party: (a) from complying (but only to the narrowest extent required by law and regulation and with due notice on any submissions to governmental agencies of the confidential or proprietary status of the information with a view toward restricting access to, and use or disclosure by, third parties) with reasonable requirements of governmental agencies to disclose information in order to receive legally required consents or permissions to manufacture or sell that Party's Products; or (b) from disclosing information under court order, but only after having made all reasonable efforts to secure the court's order to (i) limit production, use and disclosure of said information for the purposes of the case and to the narrowest class of disclosures practicable under the circumstances and (ii) hold all proceedings in camera with a sealed record.

ARTICLE 5
RESOLUTION OF DISPUTES

All claims, disputes and other matters in question arising out of, or relating to, this Agreement or the performance thereof shall be submitted to, and determined by, arbitration if good faith negotiations between the parties do not resolve such claim, dispute or other matter within 60 days. Such arbitration shall proceed in accordance with the Commercial Arbitration Rules of the American Arbitration Association then pertaining (the "Rules"), insofar as such Rules are not inconsistent with the provisions expressly set forth in this Agreement, unless the parties mutually agree otherwise, and pursuant to the following procedures:

(a) Notice of the demand for arbitration shall be filed in writing with the other Member and with the American Arbitration Association. Each Member shall appoint an arbitrator, and those party-appointed arbitrators shall appoint a third neutral arbitrator within 10 days. If the party-appointed arbitrators fail to appoint a third, neutral arbitrator within 10 days, such third, neutral arbitrator shall be appointed by the American Arbitration Association in accordance with the Rules. A determination by a majority of the panel shall be binding.

(b) Reasonable discovery shall be allowed in arbitration.

(c) All proceedings before the arbitrators shall be held in Minneapolis, Minnesota. The governing law shall be as specified in Section 8.1 below.

(d) The costs and fees of the arbitration, including attorneys' fees, shall be allocated by the arbitrators.

(e) The award rendered by the arbitrators shall be final and judgment may be entered in accordance with applicable law and in any court having jurisdiction thereof.

ARTICLE 6
NOTICES

6.1. Notices. All communications, demands, notices or objections required or permitted to be given or served under this Agreement shall be in writing and shall be deemed to have been duly given or made only if delivered in person, deposited in the United States mail, postage prepaid, for mailing by certified or registered mail, return receipt requested, or delivered by prepaid overnight courier service, addressed to the appropriate party as follows:

If to LICENSOR: Richard Disrud, COO
Aqua Innovations, Inc.
6101 Baker Rd., #206
Minnetonka, Minnesota 55435

If to LICENSEE: Jeffrey Brink, CEO
Oxygenator Water Technology, Inc.
6101 Baker Rd., #206
Minnetonka, Minnesota 55435

Either party may change its address by giving notice in writing, stating the new address, to the other Party as provided in the foregoing manner. Commencing on the tenth (10th) day after the giving of such notice, such newly designated address shall be such Party's address for the purpose of all communications, demands, notices or objections required or permitted to be given or served under this Agreement.

ARTICLE 7
MISCELLANEOUS

7.1. Governing Law; Court Proceedings. The validity, performance, and all matters relating to the interpretation and effect of this Agreement shall be governed by the internal law in effect in the State of Minnesota without regard to principles of law (such as "conflicts of law") that might make the law of some other jurisdiction applicable. Without limiting the terms set forth in Article 6 with respect to the resolution of disputes, each Party agrees to the exclusive and irrevocable jurisdiction of the federal and state courts of Minnesota for any claim, action or cause of action arising out of or in any way related to this Agreement which may be brought in a court of law and both parties agree that personal service from any such court may be effectively served upon a party at the respective addresses set forth in Section 7.1.

7.2. Exhibits. Exhibits, schedules and annexes referred to in this Agreement and attached hereto are incorporated herein in full by this reference as if each of such exhibits, schedules or annexes were set forth in the body of this Agreement and duly executed by the parties hereto.

7.3. Additional Documents and Acts. Each party agrees that it will use all reasonable efforts to take, or cause to be taken, all actions and to do, or cause to be done, all things necessary, proper or advisable, including, but not limited to, the execution of additional documents and instruments, to consummate, make effective and carry out the transactions contemplated by this Agreement.

7.4. Amendment, Modification or Waiver. No amendment, modification or waiver of any condition, provision or term of this Agreement shall be valid or of any effect unless made in writing, signed by the party or parties to be bound or its duly authorized representative and specifying with particularity the nature and extent of such amendment, modification or waiver. Any waiver by any party of a default of another party shall not affect or impair any right arising from any subsequent default.

7.5. Severable Provisions. Whenever possible, each provision of this Agreement will be interpreted in such manner as to be effective and valid under applicable law, but if any provision of this Agreement is held to be invalid, illegal or unenforceable under any applicable law or rule in any jurisdiction, such provision will be ineffective only to the extent of such invalidity, illegality, or unenforceability in such jurisdiction, without invalidating the remainder of this Agreement in such jurisdiction or any provision hereof in any other jurisdiction.

7.6. Entire Agreement. This Agreement contains the entire understanding of the parties hereto in respect of the transactions contemplated hereby and supersedes all prior agreements and understandings between the parties with respect to such subject matter.

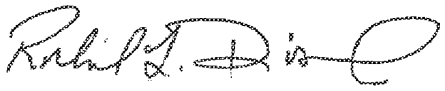
7.7. Captions, Headings, Titles or References to Gender. All captions, headings

or titles in the paragraphs or sections of this Agreement are inserted for convenience of reference only and shall not constitute a part of this Agreement or as a limitation of the scope of the particular paragraphs or sections to which they apply. Where appropriate, the masculine gender may be read as the feminine gender or the neuter gender, the feminine gender may be read as the masculine gender or the neuter gender and the neuter gender may be read as the masculine gender or the feminine gender.

7.8. Counterparts. This Agreement may be executed in two (2) or more counterparts, each of which shall be considered one and the same Agreement and shall become effective when one or more counterparts have been signed by each of the parties and delivered to the other parties.

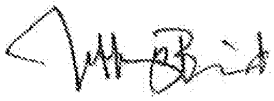
IN WITNESS WHEREOF, the parties have executed this Agreement on the date first written above.

AQUA INNOVATIONS, INC.



Dick Disrud its COO

OXYGENATOR WATER TECHNOLOGIES, INC.



Jeff Brink its CEO

EXHIBIT "A"

DESCRIPTION OF LICENSOR PATENTS AND PATENTS PENDING

United States Patent Number: US 6,689,262 B2
Date of Patent: February 10, 2004
Name: Microbubbles of Oxygen
Application Number: 10/372,017

An oxygen emitter which is an electrolytic cell. When the anode and cathode are separated by a critical distance, very small microbubbles and nanobubbles of oxygen are generated. The hydrogen forms bubbles at the cathode, which bubbles rise to the surface. The very small oxygen bubbles remain in suspension, forming a solution supersatured in oxygen.

United States Patent Number: US 7,396,441 B2
Publication Date: July 8, 2008
Name: Flow-Thru Oxygenator
Application Number: 10/732,326

An oxygen emitter which is an electrolytic cell. When the anode and cathode are separated by a critical distance, very small microbubbles and nanobubbles of oxygen are generated. The hydrogen forms bubbles at the cathode, which bubbles rise to the surface. The very small oxygen bubbles remain in suspension, forming a solution supersatured in oxygen. A flow-through model for oxygenating flowing water. The use of supersaturated water for enhancing the growth of plants. Method of applying supersaturated water to plants manually, by drip irrigation or in hydroponic culture. The treatment of waste water by raising the dissolved oxygen with the use of oxygen emitter.

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12/023,431 FLOW-THROUGH OXYGENATOR

Select New Case | Application Data | Transaction History | Image File Wrapper | Patent Term Adjustments | Continuity Data | Fees | Published Documents | Address & Attorney/Agent

Bibliographic Data

Application Number:	12/023,431	Customer Number:	
Filing or 371 (c) Date:	01-31-2008	Status:	Patented Case
Application Type:	Utility	Status Date:	02-10-2010
Examiner Name:	ALLEN, CAMERON J	Location:	ELECTRONIC
Group Art Unit:	1797	Location Date:	
Confirmation Number:	7381	Earliest Publication No:	US 2008-0179259 A1
Attorney Docket Number:	40S6.02US03	Earliest Publication Date:	07-31-2008
Class / Subclass:	210/748	Patent Number:	7,670,495
First Named Inventor:	James Andrew Senkiw , Minneapolis, MN (US)	Issue Date of Patent:	03-02-2010

Title of Invention: FLOW-THROUGH OXYGENATOR

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THIS PATENT ISSUED 3/2/2010. IN DISCUSSION WITH PAUL HANN, IT GIVES US BROAD COVERAGE.

United States Patent **7,670,495**
Senkiw **March 2, 2010**

Flow-through oxygenator

Abstract

An oxygen emitter which is an electrolytic cell is disclosed. When the anode and cathode are separated by a critical distance, very small microbubbles and nanobubbles of oxygen are generated. The very small oxygen bubbles remain in suspension, forming a solution supersaturated in oxygen. A flow-through model for oxygenating flowing water is disclosed. The use of supersaturated water for enhancing the growth of plants is disclosed. Methods for applying supersaturated water to plants manually, by drip irrigation or in hydroponic culture are described. The treatment of waste water by raising the dissolved oxygen with the use of an oxygen emitter is disclosed.

Inventors: **Senkiw; James Andrew** (Minneapolis, MN)
Assignee: **Oxygenator Water Technologies, Inc.** (Minnetonka, MN)
Appl. No.: **12/023,431**
Filed: **January 31, 2008**

Related U.S. Patent Documents

Application Number	Filing Date	Patent Number	Issue Date
10732326	Dec., 2003	7396441	
10372017	Feb., 2004	6689262	
60358534	Feb., 2002		

Current U.S. Class: 204/232; 204/245; 205/628; 210/243; 210/600
Current International Class: C02F 1/48 (20060101); C02F 1/00 (20060101); C25B 1/02 (20060101); C25B 1/04 (20060101)
Field of Search: 210/748,600,243 204/278,242,243,275.1,232,286.1,554,660 205/633-638

References Cited [Referenced By]

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1 522 188	Aug., 1978	GB
WO 99/39561	Aug., 1999	WO
WO 01/89997	Nov., 2001	WO
WO 03/072507	Sep., 2003	WO

Other References

Mohyuddin Mirza et al., "Effect of Oxygenated Water on the Growth & Biomass Development of Seedless Cucumbers and Tomato Seedlings under Greenhouse Conditions," Seair Diffusion Systems, 2003, 5 pages, www.seair.ca. cited by other.

Primary Examiner: Griffin; Walter D
Assistant Examiner: Allen; Cameron J
Attorney, Agent or Firm: Patterson, Thuente, Skaar & Christensen, P.A.

Parent Case Text

RELATED APPLICATIONS

This application is a division of application Ser. No. 10/732,326 filed Dec. 10, 2003, which in turn is a continuation-in-part of application Ser. No. 10/372,017, filed Feb. 21, 2003, now U.S. Pat. No. 6,689,262, which claims the benefit of U.S. Provisional Application No. 60/358,534, filed Feb. 22, 2002, each of which is hereby fully incorporated herein by reference.

Claims

The invention claimed is:

1. A method for treating waste water comprising; providing a flow-through oxygenator comprising an emitter for electrolytic generation of microbubbles of oxygen comprising an anode separated at a critical distance from a cathode and a power source all in electrical communication with each other, placing the emitter within a conduit; and passing waste water through the conduit.

2. An emitter for electrolytic generation of microbubbles of oxygen in an aqueous medium comprising: an anode separated at a critical distance from a cathode, a nonconductive spacer maintaining the separation of the anode and cathode, the nonconductive spacer having a spacer thickness between 0.005 to 0.050 inches such that the critical distance is less than 0.060 inches and a power source all in electrical communication with each other, wherein the critical distance results in the formation of oxygen bubbles having a bubble diameter less than 0.0006 inches, said oxygen bubbles being incapable of breading the surface tension of the aqueous medium such that said aqueous medium is supersaturated with oxygen.

3. The emitter of claim 2, wherein the anode is a metal or a metallic oxide or a combination of a metal and a metallic oxide.

4. The emitter of claim 2, wherein the anode is platinum and iridium oxide on a support.

5. The emitter of claim 2, wherein the cathode is a metal or metallic oxide or a combination of a metal and a metallic oxide.

6. The emitter of claim 2, wherein the critical distance is 0.005 to 0.060 inches.

7. The emitter of claim 2, comprising a plurality of anodes separated at the critical distance from a plurality of cathodes.

8. A method for oxygenating a non-native habitat for temporarily keeping aquatic animals, comprising: inserting the emitter of claim 2 into the aqueous medium, the non-native habitat comprising an aquarium, a bait bucket or a live well.

9. A method for lowering the biologic oxygen demand of polluted water comprising: passing the polluted water through a vessel containing the emitter of claim 2.

10. A supersaturated aqueous product formed with the emitter of claim 2, the supersaturated aqueous product having an approximately neutral pH.

11. The emitter of claim 2, further comprising a timer control.

12. The emitter of claim 2, wherein the anode and cathode are arranged such that the emitter assumes a funnel or pyramidal shaped emitter.

Description

FIELD OF THE INVENTION

This invention relates to the electrolytic generation of microbubbles of oxygen for increasing the oxygen content of flowing water. This invention also relates to the use of superoxygenated water to enhance the growth and yield of plants. The flow-through model is useful for oxygenating water for hydroponic plant culture, drip irrigation and waste water treatment.

BACKGROUND OF THE INVENTION

Many benefits may be obtained through raising the oxygen content of aqueous media. Efforts have been made to achieve higher saturated or supersaturated oxygen levels for applications such as the improvement of water quality in ponds, lakes, marshes and reservoirs, the detoxification of contaminated water, culture of fish, shrimp and other aquatic animals, biological culture and hydroponic culture. For example, fish held in a limited environment such as an aquarium, a bait bucket or a live hold tank may quickly use up the dissolved oxygen in the course of normal respiration and are then subject to hypoxic stress, which can lead to death. A similar effect is seen in cell cultures, where the respiring cells would benefit from higher oxygen content of the medium. Organic pollutants from agricultural, municipal and industrial facilities spread through the ground and surface water and adversely affect life forms. Many pollutants are toxic, carcinogenic or mutagenic. Decomposition of these pollutants is facilitated by oxygen, both by direct chemical detoxifying reactions or by stimulating the growth of detoxifying microflora. Contaminated water is described as having an increased biological oxygen demand (BOD) and water treatment is aimed at decreasing the BOD so as to make more oxygen available for fish and other life forms.

The most common method of increasing the oxygen content of a medium is by sparging with air or oxygen. While this is a simple method, the resulting large bubbles produced simply break the surface and are discharged into the atmosphere. Attempts have been made to reduce the size of the bubbles in order to facilitate oxygen transfer by increasing the total surface area of the oxygen bubbles. U.S. Pat. No. 5,534,143 discloses a microbubble generator that achieves a bubble size of about 0.10 millimeters to about 3 millimeters in diameter. U.S. Pat. No. 6,394,429 ("the '429 patent") discloses a device for producing microbubbles, ranging in size from 0.1 to 100 microns in diameter, by forcing air into the fluid at high pressure through a small orifice.

When the object of generating bubbles is to oxygenate the water, either air, with an oxygen content of about 21%, or pure oxygen may be used. The production of oxygen and hydrogen by the electrolysis of water is well known. A current is applied across an anode and a cathode which are immersed in an aqueous medium. The current may be a direct current from a battery or an AC/DC converter from a line. Hydrogen gas is produced at the cathode and oxygen gas is produced at the anode. The reactions are:

TABLE-US-00001 AT THE CATHODE: 4H.sub.2O + 4e.sup.- .fwdarw. 4OH.sup.- + 2H.sub.2 AT THE ANODE: 2H.sub.2O .fwdarw. O.sub.2 + 4H.sup.+ + 4e.sup.- NET REACTION: 6H.sub.2O .fwdarw. 4OH.sup.- + 4H.sup.+ ++ 2H.sub.2 + O.sub.2

286 kilojoules of energy is required to generate one mole of oxygen.

The gasses form bubbles which rise to the surface of the fluid and may be collected. Either the oxygen or the hydrogen may be collected for various uses. The "electrolytic water" surrounding the anode becomes acidic while the electrolytic water surrounding the cathode becomes basic. Therefore, the electrodes tend to foul or pit and have a limited life in these corrosive environments.

Many cathodes and anodes are commercially available. U.S. Pat. No. 5,982,609 discloses cathodes comprising a metal or metallic oxide of at least one metal selected from the group consisting of ruthenium, iridium, nickel, iron, rhodium, rhenium, cobalt, tungsten, manganese, tantalum, molybdenum, lead, titanium, platinum, palladium and osmium. Anodes are formed from the same metallic oxides or metals as cathodes. Electrodes may also be formed from alloys of the above metals or metals and oxides co-deposited on a substrate. The cathode and anodes may be formed on any convenient support in any desired shape or size. It is possible to use the same materials or different materials for both electrodes. The choice is determined according to the uses. Platinum and iron alloys ("stainless steel") are often preferred materials due to their inherent resistance to the corrosive electrolytic water. An especially preferred anode disclosed in U.S. Pat. No. 4,252,856 comprises vacuum deposited iridium oxide.

Holding vessels for live animals generally have a high population of animals which use up the available oxygen rapidly. Pumps to supply oxygen have high power requirements and the noise and bubbling may further stress the animals. The available electrolytic generators likewise have high power requirements and additionally run at high voltages and produce acidic and basic water which are detrimental to live animals. Many of the uses of oxygenators, such as keeping bait or caught fish alive, would benefit from portable devices that did not require a source of high power. The need remains for quiet, portable, low voltage means to oxygenate water.

It has also been known that plant roots are healthier when oxygenated water is applied. It is thought that oxygen inhibits the growth of deleterious fungi. The water sparged with air as in the '429 patent was shown to increase the biomass of hydroponically grown cucumbers and tomatoes by about 15%.

The need remains for oxygenator models suitable to be placed in-line in water distribution devices so as to be applied to field as well as hydroponic culture.

SUMMARY OF THE INVENTION

This invention provides an oxygen emitter which is an electrolytic cell which generates very small microbubbles and nanobubbles of oxygen in an aqueous medium, which bubbles are too small to break the surface tension of the medium, resulting in a medium supersaturated with oxygen.

The electrodes may be a metal or oxide of at least one metal selected from the group consisting of ruthenium, iridium, nickel, iron, rhodium, rhenium, cobalt, tungsten, manganese, tantalum, molybdenum, lead, titanium, platinum, palladium and osmium or oxides thereof. The electrodes may be formed into open grids or may be closed surfaces. The most preferred cathode is a stainless steel mesh. The most preferred mesh is a 1/16 inch grid. The most preferred anode is platinum and iridium oxide on a support. A preferred support is titanium.

In order to form microbubbles and nanobubbles, the anode and cathode are separated by a critical distance. The critical distance ranges from 0.005 inches to 0.140 inches. The preferred critical distance is from 0.045 to 0.060 inches.

Models of different size are provided to be applicable to various volumes of aqueous medium to be oxygenated. The public is directed to choose the applicable model based on volume and power requirements of projected use. Those models with low voltage requirements are especially suited to oxygenating water in which animals are to be held.

Controls are provided to regulate the current and timing of electrolysis.

A flow-through model is provided which may be connected in-line to a watering hose or to a hydroponic circulating system. The flow-through model can be formed into a tube with triangular cross-section. In this model, the anode is placed toward the outside of the tube and the cathode is placed on the inside, contacting the water flow. Alternatively, the anodes and cathodes may be in plates parallel to the long axis of the tube, or may be plates in a wafer stack. Alternately, the electrodes may be placed in a side tube ("T" model) out of the direct flow of water. Protocols are provided to produce superoxygenated water at the desired flow rate and at the desired power usage. Controls are inserted to activate electrolysis when water is flowing and deactivate electrolysis at rest.

This invention includes a method to promote growth and increase yield of plants by application of superoxygenated water. The water treated with the emitter of this invention is one example of superoxygenated water. Plants may be grown in hydroponic culture or in soil. The use of the flow-through model for drip irrigation of crops and waste water treatment is disclosed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is the O.sub.2 emitter of the invention.

FIG. 2 is an assembled device.

FIG. 3 is a diagram of the electronic controls of the O.sub.2 emitter.

FIG. 4 shows a funnel or pyramid variation of the O.sub.2 emitter.

FIG. 5 shows a multilayer sandwich O.sub.2 emitter.

FIG. 6 shows the yield of tomato plants watered with superoxygenated water.

FIG. 7 shows an oxygenation chamber suitable for flow-through applications. FIG. 7A is a cross section showing arrangement of three plate electrodes. FIG. 7B is a longitudinal section showing the points of connection to the power source.

FIG. 8 is a graph showing the oxygenation of waste water.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

For the purpose of describing the present invention, the following terms have these meanings:

"Critical distance" means the distance separating the anode and cathode at which evolved oxygen forms microbubbles and nanobubbles.

"Critical distance" means the distance separating the anode and cathode at which evolved oxygen forms microbubbles and nanobubbles.

"O.sub.2 emitter" means a cell comprised of at least one anode and at least one cathode separated by the critical distance.

"Metal" means a metal or an alloy of one or more metals.

"Microbubble" means a bubble with a diameter less than 50 microns.

"Nanobubble" means a bubble with a diameter less than that necessary to break the surface tension of water. Nanobubbles remain suspended in the water, giving the water an opalescent or milky appearance.

"Supersaturated" means oxygen at a higher concentration than normal calculated oxygen solubility at a particular temperature and pressure.

"Superoxygenated water" means water with an oxygen content at least 120% of that calculated to be saturated at a temperature.

"Water" means any aqueous medium with resistance less than one ohm per square centimeter; that is, a medium that can support the electrolysis of water. In general, the lower limit of resistance for a medium that can support electrolysis is water containing more than 2000 ppm total dissolved solids.

The present invention produces microbubbles and nanobubbles of oxygen via the electrolysis of water. As molecular oxygen radical (atomic weight 8) is produced, it reacts to form molecular oxygen, O.sub.2. In the special dimensions of the invention, as explained in more detail in the following examples, O.sub.2 forms bubbles which are too small to break the surface tension of the fluid. These bubbles remain suspended indefinitely in the fluid and, when allowed to build up, make the fluid opalescent or milky. Only after several hours do the bubbles begin to coalesce on the sides of the container and the water clears. During that time, the water is supersaturated with oxygen. In contrast, the H.sub.2 formed readily coalesces into larger bubbles which are discharged into the atmosphere, as can be seen by bubble formation at the cathode.

The first objective of this invention was to make an oxygen emitter with low power demands, low voltage and low current for use with live animals. For that reason, a small button emitter was devised. The anode and cathode were set at varying distances. It was found that electrolysis took place at very short distances before arcing of the current occurred. Surprisingly, at slightly larger distances, the water became milky and no bubbles formed at the anode, while hydrogen continued to be bubbled off the cathode. At distance of 0.140 inches between the anode and cathode, it was observed that the oxygen formed bubbles at the anode. Therefore, the critical distance for microbubble and nanobubble formation was determined to be between 0.005 inches and 0.140 inches.

EXAMPLE 1

Oxygen Emitter

As shown in FIG. 1, the oxygen evolving anode 1 selected as the most efficient is an iridium oxide coated single sided sheet of platinum on a support of titanium (Eltech, Fairport Harbor, Ohio). The cathode 2 is a (fraction (1/16)} inch mesh (size 8 mesh) marine stainless steel screen. The anode and cathode are separated by a non-conducting spacer 3 containing a gap 4 for the passage of gas and mixing of anodic and cathodic water and connected to a power source through a connection point 5. FIG. 2

shows a plan view of the assembled device. The O.sub.2 emitter 6 with the anode connecting wire 7 and the cathode connecting wire 8 is contained in an enclosure 9, connected to the battery compartment 10. The spacer thickness is critical as it sets the critical distance. It must be of sufficient thickness to prevent arcing of the current, but thin enough to separate the electrodes by no more than 0.140 inches. Above that thickness, the power needs are higher and the oxygen bubbles formed at higher voltage will coalesce and escape the fluid. Preferably, the spacer is from 0.005 to 0.075 inches thick. At the lower limits, the emitter tends to foul more quickly. Most preferably, the spacer is about 0.050 inches thick. The spacer may be any nonconductive material such as nylon, fiberglass, Teflon.RTM., polymer or other plastic. Because of the criticality of the space distance, it is preferable to have a non-compressible spacer. It was found that Buna, with a durometer measure of 60 was not acceptable due to decomposition. Viton, a common fluoroelastomer, has a durometer measure of 90 and was found to hold its shape well.

In operation, a small device with an O.sub.2 emitter 1.485 inches in diameter was driven by 4AA batteries. The critical distance was held at 0.050 inches with a Viton spacer. Five gallons of water became saturated in seven minutes. This size is suitable for raising oxygen levels in an aquarium or bait bucket.

It is convenient to attach a control circuit which comprises a timer that is thermostatically controlled by a temperature sensor which determines the off time for the cathode. When the temperature of the solution changes, the resistance of the thermistor changes, which causes an off time of a certain duration. In cool water, the duration is longer so in a given volume, the emitter generates less oxygen. When the water is warmer and therefore hold less oxygen, the duration of off time is shorter. Thus the device is self-controlled to use power most economically. FIG. 3 shows a block diagram of a timer control with anode 1, cathode 2, thermistor temperature sensor 3, timer control circuit 4 and wire from a direct current power source 5.

EXAMPLE 2

Measurement of O.sub.2 Bubbles

Attempts were made to measure the diameter of the O.sub.2 bubbles emitted by the device of Example 1. In the case of particles other than gasses, measurements can easily be made by scanning electron microscopy, but gasses do not survive electron microscopy. Large bubble may be measured by pore exclusion, for example, which is also not feasible when measuring a gas bubble. A black and white digital, high contrast, backlit photograph of treated water with a millimeter scale reference was shot of water produced by the emitter of Example 1. About 125 bubbles were seen in the area selected for measurement. Seven bubbles ranging from the smallest clearly seen to the largest were measured. The area was enlarged, giving a scale multiplier of 0.029412.

Recorded bubble diameters at scale were 0.16, 0.22, 0.35, 0.51, 0.76, 0.88 and 1.09 millimeters. The last three were considered outliers by reverse analysis of variance and were assumed to be hydrogen bubbles. When multiplied by the scale multiplier, the assumed O.sub.2 bubbles were found to range from 4.7 to 15 microns in diameter. This test was limited by the resolution of the camera and smaller bubbles in the nanometer range could not be resolved. It is known that white light cannot resolve features in the nanometer size range, so monochromatic laser light may give resolution sensitive enough to measure smaller bubbles. Efforts continue to increase the sensitivity of measurement so that sub-micron diameter bubbles can be measured.

EXAMPLE 3

Other Models of Oxygen Emitter

Depending on the volume of fluid to be oxygenated, the oxygen emitter of this invention may be shaped as a circle, rectangle, cone or other model. One or more may be set in a substrate that may be metal, glass, plastic or other material. The substrate is not critical as long as the current is isolated to the electrodes by the nonconductor spacer material of a thickness from 0.005 to 0.075 inches, preferably 0.050 inches. It has been noticed that the flow of water seems to be at the periphery of the emitter, while the evolved visible bubbles (H.sub.2) arise at the center of the emitter. Therefore, a funnel or pyramidal shaped emitter was constructed to treat larger volumes of fluid. FIG. 4 is a cross sectional diagram of such an emitter. The anode 1 is formed as an open grid separated from a marine grade stainless steel screen cathode 2 by the critical distance by spacer 3 around the periphery of the emitter and at the apex. This flow-through embodiment is suitable for treating large volumes of water rapidly.

The size may be varied as required. A round emitter for oxygenating a bait bucket may be about 2 inches in diameter, while a 3-inch diameter emitter is adequate for oxygenating a 10 to 40 gallon tank. The live well of a fishing boat will generally hold 40 to 80 gallons of water and require a 4-inch diameter emitter. It is within the scope of this invention to construct larger emitters or to use several in a series to oxygenate larger volumes. It is also within the scope of this invention to vary the model to provide for low voltage and amperage in cases where the need for oxygen is moderate and long lasting or conversely, to supersaturate water very quickly at higher voltage and amperage. In the special dimensions of the present invention, it has been found that a 6 volt battery supplying a current as low as 40 milliamperes is sufficient to generate oxygen. Such a model is especially useful with live plants or animals, while it is more convenient for industrial use to use a higher voltage and current. Table I shows a number of models suitable to various uses.

TABLE-US-00002 TABLE I Emitter Model Gallons Volts Amps Max. Ave Watts Bait keeper 5 6 0.090 0.060 0.36 Livewell 32 12 0.180 0.120 1.44 OEM 2 inch 10 12 0.210 0.120 1.44 Bait store 70 12 0.180 0.180 2.16 Double cycle 2 12 0.180 0.180 2.16 OEM 3 inch 50 12 0.500 0.265 3.48 OEM 4 inch 80 12 0.980 0.410 4.92 Water pail 2 24 1.200 1.200 28.80 Plate 250 12 5.000 2.500 30.00

EXAMPLE 4

Multilayer Sandwich O.sub.2 Emitter

An O.sub.2 emitter was made in a multilayer sandwich embodiment. (FIG. 5) An iridium oxide coated platinum anode 1 was formed into a grid to allow good water flow and sandwiched between two stainless steel screen cathodes 2. Spacing was held at the critical distance by nylon spacers 3. The embodiment illustrated is held in a cassette 4 which is secured by nylon bolt 5 with a nylon washer 6. The dimensions selected were:

TABLE-US-00003 cathode screen 0.045 inches thick nylon spacer 0.053 inches thick anode grid 0.035 inches thick nylon spacer 0.053 inches thick cathode screen 0.045 inches thick,

for an overall emitter thickness of 0.231 inches thick inches.

If a more powerful emitter is desired, it is within the scope of this invention to repeat the sequence of stacking. For example, an embodiment may easily be constructed with this sequence: cathode, spacer, anode, spacer, cathode, spacer, anode, spacer, cathode, spacer, anode, spacer, cathode. The number of layers in the sandwich is limited only by the power requirements acceptable for an application.

EXAMPLE 5

Effect of Superoxygenated Water on the Growth of Plants

It is known that oxygen is important for the growth of plants. Although plants evolve oxygen during photosynthesis, they also have a requirement for oxygen for respiration. Oxygen is evolved in the leaves of the plants, while often the roots are in a hypoxic environment without enough oxygen to support optimum respiration, which can be reflected in less than optimum growth and nutrient utilization. Hydroponically grown plants are particularly susceptible to oxygen deficit in the root system. U.S. Pat. No. 5,887,383 describes a liquid supply pump unit for hydroponic cultures which attain oxygen enrichment by sparging with air. Such a method has high energy requirements and is noisy. Furthermore, while suitable for self-contained hydroponic culture, the apparatus is not usable for field irrigation. In a report available on the web, it was shown that hydroponically grown cucumbers and tomatoes supplied with water oxygenated with a device similar to that described in the '429 patent had increased biomass of about 12% and 17% respectively. It should be noted that when sparged with air, the water may become saturated with oxygen, but it is unlikely that the water is superoxygenated.

A. Superoxygenated Water in Hydroponic Culture.

Two small hydroponic systems were set up to grow two tomato plants. Circulation protocols were identical except that the 2 1/2 gallon water reservoir for the Control plant was eroated with and aquarium bubbler and that for the Test plant was oxygenated with a five-inch strip emitter for two minutes prior to pumping. The cycle was set at four minutes of pumping, followed by four minutes of rest. The control water had an oxygen content of about 97% to 103% saturation, that is, it was saturated with oxygen. The test water had an oxygen content of about 153% to 165% saturation, that is, it was supersaturated. The test plant was at least four times the volume of the control plant and began to show what looked like fertilizer burn. At that point the fertilizer for the Test plant was reduced by half. Since the plants were not exposed to natural light but to continuous artificial light in an indoor environment without the natural means of fertilization (wind and/or insects), the experiment was discontinued after three months. At that time, the Test plant but not the Control plant had blossomed.

B. Superoxygenated Water in Field Culture.

A pilot study was designed to ascertain that plants outside the hydroponic culture facility would benefit from the application of oxygen. It was decided to use water treated with the emitter of Example 1 as the oxygen carrier. Since water so treated is supersaturated, it is an excellent carrier of oxygen.

Tomato seeds (Burpee "Big Boy") were planted in one-inch diameter peat and dirt plugs encased in cheese cloth and placed in a tray in a southwest window. Controls were watered once a day with tap water ("Control") or oxygenated water ("Test"). Both Controls and Test sprouted at one week. After five weeks, the Test plants were an average of 11 inches tall while the Controls were an average of nine inches tall. At this time, May 10, when the threat of frost in Minnesota was minimal, the plants were transplanted to 13 inch diameter pots with drainage holes. Four inches of top soil was added to each pot, topped off with four inches of Scott's Potting Soil. The pots were placed outside in a sunny area with at least eight hours a day of full sun. The plants were watered as needed with either plain tap water (Control) or oxygenated water (Test). The oxygenated water was produced by use of the emitter of Example 1 run for one-half hour in a five-gallon container of water. Previous experiments showed that water thus treated had an oxygen content from 160% to 260% saturation. The Test plants flowered on June 4, while the Controls did not flower until June 18. For both groups, every plant in the group first had flowers on the same day. All plants were fertilized on July 2 and a soaker hose provided because the plants were now so big that watering by hand was difficult. The soaker hose was run for one half to one hour each morning, depending on the weather, to a point at which the soil was saturated with water. One

half hour after the soaker hose was turned off, about 750 ml of superoxygenated water was applied to each of the Test plants.

The Test plants were bushier than the Controls although the heights were similar. At this time, there were eight Control plants and seven Test plants because one of the Test plants broke in a storm. On July 2, the control plants averaged about 17 primary branches from the vine stem, while the control plants averaged about 13 primary branches from the vine stem. As the tomatoes matured, each was weighed on a kitchen scale at harvest. The yield history is shown in Table II.

TABLE-US-00004 TABLE II Control, grams Test, grams tomatoes from tomatoes from eight plants/ seven plants/ Week of: cumulative total cumulative total July 27 240 400 August 3 180 420 2910 3310 August 10 905 1325 1830 5140 August 17 410 1735 2590 7730 August 24 3300 5035 2470 10200 August 31 4150 9175 1580 11780 September 15 not weighed 3710 15490 Final Harvest 6435 15620 8895 24385 September 24

The total yield for the eight Control plants was 15620 grams or 1952 grams of tomatoes per plant.

The total yield for the seven Test plants was 24385 grams or 3484 grams of tomatoes per plant, an increase in yield of about 79% over the Control plants.

FIG. 6 shows the cumulative total as plotted against time. Not only did the Test plants blossom and bear fruit earlier, but that the Control plants never caught up to the test plants in the short Minnesota growing season. It should be noted that the experiment was terminated because of predicted frost. All fruits, both green and red, were harvested and weighed at that point.

EXAMPLE 6

Flow-Through Emitter for Agricultural Use

In order to apply the findings of example 5 to agricultural uses, an emitter than can oxygenate running water efficiently was developed. In FIG. 7(A), the oxygenation chamber is comprised of three anodes 1 and cathodes 2, of appropriate size to fit inside a tube or hose and separated by the critical distance are placed within a tube or hose 3 at 120.degree. angles to each other. The anodes and cathodes are positioned with stabilizing hardware 4. The stabilizing hardware, which can be any configuration such as a screw, rod or washer, is preferably formed from stainless steel. FIG. 7(B) shows a plan view of the oxygenation chamber with stabilizing hardware 4 serving as a connector to the power source and stabilizing hardware 5 serving as a connector to the power source. The active area is shown at 6.

This invention is not limited to the design selected for this embodiment. Those skilled in the art can readily fabricate any of the emitters shown in FIG. 4 or 5, or can design other embodiments that will oxygenate flowing water. One useful embodiment is the "T" model, wherein the emitter unit is set in a side arm. The emitted bubbles are swept into the water flow. The unit is detachable for easy servicing. Table III shows several models of flow through emitters. The voltage and flowrates were held constant and the current varied. The Dissolved oxygen (DO) from the source was 7.1 mg/liter. The starting temperature was 12.2.degree. C. but the flowing water cooled slightly to 11 or 11.5.degree. C. Without undue experimentation, anyone may easily select the embodiment that best suits desired characteristics from Table III or designed with the teachings of Table III.

TABLE-US-00005 TABLE III ACTIVE DO OF* ELECTRODE CURRENT, FLOW RATE SAMPLE AT MODEL AREA, SQ.IN. VOLTAGE AMPS. GAL/MINUTE ONE MINUTE 2-Inch "T" 2 28.3 0.72 12 N/A 3-inch "T" 3 28.3 1.75 12 N/A 2-plate Tube 20 28.3 9.1 12 8.4 3-Plate tube 30 28.3 12.8 12 9.6

*As the apparatus runs longer, the flowing water becomes milky, indicating supersaturation. The one-minute time point shows the rapid increase in oxygenation.

The following plants will be tested for response to superoxygenated water: grape vines, lettuce, and radishes in three different climate zones. The operators for these facilities will be supplied with units for drip irrigation. Drip irrigation is a technique wherein water is pumped through a pipe or hose with perforations at the site of each plant to be irrigated. The conduit may be underground or above ground. Since the water is applied directly to the plant rather than wetting the entire field, this technique is especially useful in arid climates or for plants requiring high fertilizer applications.

The superoxygenated water will be applied by drip irrigation per the usual protocol for the respective plants. Growth and yield will be compared to the same plants given only the usual irrigation water. Pest control and fertilization will be the same between test and control plants, except that the operators of the experiments will be cautioned to be aware of the possibility of fertilizer burn in the test plants and to adjust their protocols accordingly.

It is expected that the superoxygenated plants with drip irrigation will show more improved performance with more continuous application of oxygen than did the tomato plants of Example 5, which were given superoxygenated water only once a day.

EXAMPLE 7

Treatment of Waste Water

Waste water, with a high organic content, has a high BOD, due to the bacterial flora. It is desirable to raise the oxygen content of the waste water in order to cause the flora to flocculate. However, it is very difficult to effectively oxygenate such water. Using a 4 inch OEM (see Table I) with a 12 volt battery, four liters of waste water in a five gallon pail were oxygenated. As shown in FIG. 8, the dissolved oxygen went from 0.5 mg/l to 10.8 mg/l in nine minutes.

Those skilled in the art will readily comprehend that variations, modifications and additions may in the embodiments described herein may be made. Therefore, such variations, modifications and additions are within the scope of the appended claims.

* * * * *

AGREEMENT OF STRICT FORECLOSURE

THIS AGREEMENT OF STRICT FORECLOSURE (the "Agreement") is made, entered into and effective as of October 4, 2012 (the "Effective Date"), by and between AQUA INNOVATIONS INCORPORATED ("Debtor"), a Minnesota corporation, and ROY H. LECY ("Secured Party"), who holds a certain security interest in the assets of Debtor as set forth below as security under a certain Promissory Note dated December 1, 2006, executed by Debtor in favor of Secured Party in the principal amount of Two Hundred Eighteen Thousand Eight Hundred Twenty-Seven and 29/100 Dollars ($218,827.49) (the "Note"). Either Debtor or Secured Party may be individually referred to herein as a "party" or collectively as the "parties."

RECITALS

WHEREAS, Secured Party is a shareholder of Debtor who holds nine hundred twenty-eight thousand three hundred thirty-four (928,334) shares of Debtor's common stock and twenty-six thousand six hundred sixty-seven (26,667) shares of Debtor's Preferred Series A stock; and

WHEREAS, Secured Party loaned Debtor various amounts of money over the course of several years, as documented in the Note; and

WHEREAS, Debtor is in default of its obligations pursuant to the Note; and

WHEREAS, as of December 31, 2011, the sum of Two Hundred Seven Thousand Ninety-Eight and no/100 Dollars ($207,098.00) remains due and owing Secured Party from Debtor (the "Outstanding Debt"); and

WHEREAS, the Note provides Secured Party a security interest in all of Debtor's "patents and physical assets"; and

WHEREAS, Secured Party perfected his security interest via the filing of a Uniform Commercial Code Financing Statement with the Minnesota Secretary of State on or about February 10, 2012, Filing Number 201227190568; and

WHEREAS, Secured Party is currently the only secured creditor of Debtor; and

WHEREAS, Debtor is no longer a going business concern; and

WHEREAS, Debtor has no viable assets other than its rights as Licensee under that certain License Agreement dated July 30, 2008 (the "License Agreement"), a copy of which is attached hereto as Exhibit A, entered into by and between Debtor and Oxygenator Water Technologies, Inc. ("OWT"), a Minnesota corporation, pursuant to which Debtor holds certain perpetual, exclusive and royalty free licenses as further described in the License Agreement, any property of Debtor as set forth in the License Agreement, including but not limited to any Licensee Documents, Licensee Improvements, Licensee Patents, Licensee Products, Licensee Property or Licensee Technology, all as defined in the License Agreement and certain shares of

OWT's common stock held by Debtor (the "OWT Stock" or collectively with the License Agreement and the other property of Debtor set forth herein, the "Collateral"); and

WHEREAS, Secured Party, as Debtor's sole secured creditor, is entitled to foreclose on the Collateral securing the Note; and

WHEREAS, Secured Party has agreed and Debtor has consented to Secured Party's acceptance of the Collateral in full satisfaction of Debtor's obligations under the Note in accordance with Sections 9-620 through 9-622 of the Uniform Commercial Code (the "UCC"), as adopted in the State of Minnesota as Minnesota Statutes Sections 336.9-620 through 336.9-622.

AGREEMENTS

NOW, THEREFORE, in consideration of the foregoing, Debtor and Secured Party hereto agree as follows:

1. **Recitals**. Debtor hereby acknowledges that the recitals set forth above are true and correct and such recitals are hereby made a part of this Agreement.

2. **Conveyance of Collateral; Satisfaction of Outstanding Debt**. Pursuant to Minnesota Statutes Sections 336.9-620 through 336.9-622, Debtor assigns all right, title and interest in and to the Collateral to Secured Party, agrees to immediately surrender the Collateral to Secured Party and Secured Party shall retain the Collateral in full satisfaction of the Outstanding Debt. Debtor shall deliver the Stock Powers Certificate (Assignment Separate from Certificate) for the OWT Stock attached hereto as Exhibit B to Secured Party contemporaneous with Debtor's execution of this Agreement. Secured Party does not assume, and nothing herein shall be construed to obligate Secured Party to pay, any leases, liabilities or obligations of Debtor.

3. **Waiver**. Pursuant to Section 9-624 of the UCC, Minnesota Statutes Section 336.9-624, Debtor hereby waives and renounces all of its rights to notification under Section 9-611 of the UCC, Minnesota Statutes Section 336.9-611, or any other state in which any Collateral may be located as to the sale or other disposition by Secured Party of the Collateral and all rights under Sections 9-620 and 9-623 of the UCC, Minnesota Statutes Sections 336.9-620 and 336.9-623, regarding acceptance of collateral as discharge of the obligations of Debtor to Secured Party, mandatory disposition of the Collateral and the waiver of Debtor's rights to redeem collateral, respectively. Debtor further knowingly and intelligently waives any rights it may have to notice and a hearing before a court of competent jurisdiction.

4. **Representations and Warranties**. Debtor represents and warrants the following:

4.1 Debtor has the power and is duly authorized to enter into and perform this Agreement, and Debtor has complied with and is in good standing with respect to all laws, statutes and ordinances of all federal, state and local governmental entities having jurisdiction over them. Debtor hereby represents and warrants that this Agreement is a legal, valid and binding agreement, enforceable in accordance

with its terms and shall be binding upon Debtor and its respective representatives, successors and assigns.

4.2 Debtor represents, warrants and covenants that it has valid title to all of the Collateral being turned over herewith.

5. [Intentionally Omitted].

6. **Representation by Counsel**. Debtor acknowledges that it has been represented by legal counsel of its choice, Jamie R. Pierce of Hinshaw & Culbertson, LLP, in connection with the execution and delivery of this Agreement.

7. **Notices**. Any notice required or permitted under this Agreement shall be in writing and shall be deemed to be given when and if sent by certified mail, return receipt requested, postage pre-paid, properly addressed as follows, or such other address as may hereafter be designated in writing by either of the parties:

Secured Party:

Roy Lecy
c/o Nathan M. Brandenburg
Siegel Brill, P.A.
100 Washington Avenue South, Suite 1300
Minneapolis, MN 55401

Debtor:

Aqua Innovations Incorporated
6101 Baker Road, Suite 206
Minnetonka, MN 55345

With a copy to:

Jamie R. Pierce
Hinshaw & Culbertson, LLP
333 South Seventh Street, Suite 2000
Minneapolis, MN 55402

8. **Amendments, Waivers, Assignment**. No amendment, waiver or assignment of the provisions of this Agreement shall be effective unless the same shall be in writing and be signed by the party against whom it is to be enforced, and then such amendment, waiver or assignment shall be effective only in the specific interest and for the specific purpose which given.

9. **Necessary Documents**. The parties agree that they shall execute any and all documents necessary to carry out the terms and conditions of this Agreement.

10. **Governing Law; Venue**. This Agreement shall be governed and construed under and in accordance with the laws of the State of Minnesota. Any dispute arising under this Agreement

and/or between the parties shall be venued in the state and federal courts located in Minneapolis, Minnesota.

11. **Entire Agreement**. This Agreement contains the entire Agreement by and between the parties hereto with respect to the transactions contemplated herein, which shall supersede any prior oral negotiations and agreements and shall be binding upon the parties hereto and their successors and assigns.

12. **Merger**. All prior oral and written communications, commitments, alleged commitments, promises, alleged promises, agreements and alleged agreements by or between Secured Party and Debtor are hereby merged into this Agreement.

13. **Severability**. If any part of this Agreement is held to be illegal, invalid or unenforceable, the remainder of this Agreement shall continue in full force and effect, notwithstanding such illegality, invalidity or unenforceability.

14. **Headings**. The section headings in this Agreement are included herein for convenience or reference only and shall not constitute a part of this Agreement for any other purposes.

15. **Successors and Assigns**. This Agreement shall be binding upon and shall inure to the benefit of the parties hereto and their respective successors and assigns, except that Debtor may not assign or transfer its rights or obligations hereunder without the prior written consent of Secured Party.

16. **Counterparts**. This Agreement may be executed in one or more counterparts, each of which shall be deemed to be an original and all of which shall constitute one and the same instrument.

17. **Indemnification**. Debtor agrees to indemnify, defend and hold Secured Party, his respective employees, agents, representatives and attorneys harmless from any claim or cause of action (except for a claim of fraud against Secured Party) by any third party based in whole or in part upon the terms of this Agreement or their actions or omissions in fulfilling or enforcing this Agreement or based upon any failure by Debtor to pay all taxes, or other indebtedness or fulfill any obligations they may have with other third parties which may be affected by this Agreement or the omissions or actions of the parties relative thereto.

[This space intentionally left blank; signature page follows.]

IN WITNESS WHEREOF, Secured Party and Debtor hereto have executed this Agreement as of the Effective Date.

Debtor: **Aqua Innovations Incorporated**

By: Janel J. Fish
Its: Chief Executive Officer

STATE OF MINNESOTA)
) ss.
COUNTY OF HENNEPIN)

This document was acknowledged before me on October 4, 2012, by Janel Fish, as Chief Executive Officer of Aqua Innovations Incorporated, a Minnesota corporation.

Notary Stamp:

LAURIE LYNN HONZA
Notary Public-Minnesota
My Commission Expires Jan 31, 2015

Laurie Honza
Notary Signature

Secured Party:

Roy H. Lecy

STATE OF MINNESOTA)
) ss.
COUNTY OF HENNEPIN)

This document was acknowledged before me on September ____, 2012, by Roy H. Lecy, an individual resident of the State of Minnesota.

Notary Stamp:

Notary Signature

M:\26141-001\Strict Foreclosure Agreement 05

IN WITNESS WHEREOF, Secured Party and Debtor hereto have executed this Agreement as of the Effective Date.

Debtor: **Aqua Innovations Incorporated**

By: _____
Its: _____

STATE OF MINNESOTA)
) ss.
COUNTY OF HENNEPIN)

This document was acknowledged before me on September ____, 2012, by _____, as _____ of Aqua Innovations Incorporated, a Minnesota corporation.

Notary Stamp:

_____
Notary Signature

Secured Party:

Roy H. Lecy

STATE OF MINNESOTA)
) ss.
COUNTY OF HENNEPIN)

This document was acknowledged before me on ~~September~~ October 8, 2012, by Roy H. Lecy, an individual resident of the State of Minnesota.

Notary Stamp:

TARI K. HAUNTY
Notary Public-Minnesota
My Commission Expires Jan 31, 2015

Tari K. Haunty
Notary Signature

M:\26141-001\Strict Foreclosure Agreement 05

EXHIBIT A
LICENSE AGREEMENT

EXHIBIT A
LICENSE AGREEMENT

AMENDMENT TO LICENSE AGREEMENT

THIS AMENDMENT TO LICENSE AGREEMENT (the "Amendment"), is made, entered into and effective as of October 4, 2012, by and between OXYGENATOR WATER TECHNOLOGIES, INC. ("Licensor"), a Minnesota corporation doing business as Water D.O.G. Works, and ROY H. LECY ("Lecy"), and amends certain terms of that certain License Agreement dated July 30, 2008 (the "License Agreement"), entered into by and between Licensor and Aqua Innovations Incorporated ("Aqua"), a Minnesota corporation. Licensor and Lecy may be individually referred to herein as a "party" or collectively as the "parties."

WHEREAS, Licensor, as Licensor, and Aqua, as Licensee, entered into the License Agreement on or about July 30, 2008, a copy of which is attached hereto as Exhibit A; and

WHEREAS, pursuant to an Agreement of Strict Foreclosure dated October 4, 2012, Aqua conveyed all right, title and interest it held in the License Agreement to Lecy; and

WHEREAS, the parties desire to formally amend the License Agreement to reflect Lecy's interest in the Agreement via this Amendment.

NOW THEREFORE, it is hereby agreed as follows:

1. **Incorporation of Recitals**. The recitals set forth above are true and correct and incorporated as if fully stated herein.

2. **Amendment of License Agreement**. All references in the License Agreement to Licensee shall mean Roy H. Lecy and not Aqua. Licensor hereby acknowledges the acquisition by Lecy of all right, title and interest of Aqua in the License Agreement and further acknowledges and agrees that the License Agreement is a binding contract in full force and effect and that Lecy may assign his interest therein at will.

3. **Remaining Terms in Full Force and Effect**. No other terms of the License Agreement or any schedule or exhibit thereto shall be amended or modified in any way and the License Agreement shall remain in full force and effect as amended via this Amendment and the parties hereby reaffirm their respective obligations thereunder.

Oxygenator Water Technologies, Inc.

By: Mark A. Peters
Its: President
10-24-2012

Roy H. Lecy

PATENT ASSIGNMENT

Electronic Version v1.1
Stylesheet Version v1.1

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	LICENSE

CONVEYING PARTY DATA

Name	Execution Date
Roy H Lecy	10/04/2012

RECEIVING PARTY DATA

Name:	O2 Marine Technologies, Inc.
Street Address:	6651 Hazeltine Boulevard
City:	Excelsior
State/Country:	MINNESOTA
Postal Code:	55331

PROPERTY NUMBERS Total: 3

Property Type	Number
Patent Number:	6689262
Patent Number:	7396441
Patent Number:	7670495

CH $120.00 6689262

CORRESPONDENCE DATA

Fax Number: 6123396591
Correspondence will be sent via US Mail when the fax attempt is unsuccessful.
Phone: 6123376100
Email: nathanbrandenburg@siegelbrill.com
Correspondent Name: Nathan M. Brandenburg
Address Line 1: 100 Washington Avenue South
Address Line 2: Suite 1300
Address Line 4: Minneapolis, MINNESOTA 55401

ATTORNEY DOCKET NUMBER:	25991-002
NAME OF SUBMITTER:	Nathan M. Brandenburg
Signature:	/nathanmbrandenburg/

Date:	04/30/2013
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 5
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PATENT SUBLICENSE AGREEMENT

THIS PATENT SUBLICENSE AGREEMENT (this "Agreement") is made, entered into and effective as of October 4, 2012 (the "Effective Date") by and between ROY H. LECY ("Sublicensor"), a Minnesota resident, and O2 MARINE TECHNOLOGIES, INC. ("Sublicensee"), a Minnesota corporation. Sublicensor or Sublicensee may be individually referred to herein as a "party" or collectively as the "parties."

WHEREAS, Sublicensor is the holder of certain patent licenses as set forth in a certain License Agreement dated July 30, 2008, entered into by and between Oxygenator Water Technologies, Inc. ("OWT"), as Licensor, and Aqua Innovations Incorporated ("Aqua"), as Licensee (the "License Agreement"), as amended via a certain Amendment to License Agreement dated October 4, 2012 (the "Amendment" or collectively with the License Agreement, the "License Agreement"), pursuant to which Roy H. Lecy acquired all right title and interest of Aqua in the License Agreement; and

WHEREAS, copies of the License Agreement and Amendment are attached hereto as Exhibit A.

NOW THEREFORE, the parties hereby agree as follows:

ARTICLE ONE
GRANT OF SUBLICENSE

1.1 **License**. Sublicensor warrants he holds a valid license pursuant to the License Agreement for United States Patent Number 6,689,262 B2 issued on February 10, 2004, entitled "Microbubbles of oxygen," United States Patent Number 7,396,441 B2 issued on July 8, 2008, entitled "Flow-through oxygenator," and United States Patent Number 7,670,495 issued on March 2, 2010, entitled "Flow-through oxygenator" (collectively, the "Licensed Patents" or each a "Licensed Patent").

1.2 **Grant of Sublicense**. Effective upon execution of this Agreement, and for consideration stated in Article Three of this Agreement, Sublicensor grants to Sublicensee a royalty based, limited, exclusive sublicense to make, sell, and offer for sale products covered by the Licensed Patents in the United States and to sell and offer for sale in any country products covered by the Licensed Patents (the "Licensed Products"), subject to the limitations set forth in this Agreement. The Licensed Patents are sublicensed "As Is" and without warranty of any kind by Sublicensor.

ARTICLE TWO
LICENSED FIELD

2.1 **Licensed Field**. Sublicensee may sell and offer for sale only Licensed Products manufactured for retail sale and use in the sport fishing industry (the "Licensed Field") and for no other purposes. Sublicensee hereby agrees to offer for sale and to sell only the Licensed Products in the Licensed Field. Sublicensee acknowledges and agrees that if Sublicensee offers for sale or sells the Licensed Products outside the Licensed Field such activity by Sublicensee will be deemed a material breach of this Agreement and Sublicensor shall have the right to terminate this Agreement without notice.

ARTICLE THREE
ROYALTY

3.1 **Royalty**. Sublicensee shall pay royalties to Sublicensor at a rate of five percent (5%) of the net receipts realized by Sublicensee upon any Licensed Products sold by Sublicensee. For purposes of this Agreement, "net receipts" shall mean gross sale proceeds, less cost of goods sold, freight, discounts offered by Sublicensee, returns and other costs or expenses incurred by Sublicensee in the manufacture and sale of the Licensed Products. Any royalties shall be paid to Sublicensor on a calendar quarterly basis, sixty (60) days after the end of each calendar quarter (May 30, August 30, December 30 and March 1 or 2).

3.2 **Accounting**. For all Licensed Products sold by Sublicensee, Sublicensee will account to Sublicensor on a calendar quarterly basis, indicating the number of Licensed Products sold within thirty (30) days following the end of each calendar quarter for the term hereof. Sublicensee shall make such accountings to Sublicensor via paper or electronic accounting statements in a mutually accepted compatible format. Sublicensee agrees to keep and maintain true and accurate records and books of account in connection with all sales related to any such products and all transactions related thereto or otherwise contemplated under this Agreement, and shall retain all such records and books for a period of not less than five (5) years after each accounting to Sublicensor. Sublicensor, by its designated representative, shall have the right, upon reasonable written notice, and during normal office hours, to examine the books and records of Sublicensee, as the same pertain to the subject matter of this Agreement, and to make copies and extracts thereof. Sublicensee shall cooperate with Sublicensor's representatives to assist them in understanding all such material. If, as a result of any audit, it is determined that Sublicensee has understated the royalties due to Sublicensor by ten percent (10%) or more, Sublicensee shall pay to Sublicensor the amount by which royalties have been understated plus a ten percent (10%) penalty fee, and shall reimburse Sublicensor for the cost of the audit.

ARTICLE FOUR
PACKAGING

4.1 **Packaging**. Sublicensee shall use its own tradename or trade or servicemark on the packaging for the Licensed Products. In no event shall Sublicensee use any of Sublicensor's trademarks on the packaging for the Licensed Products.

ARTICLE FIVE
LICENSED PRODUCT REVIEW

5.1 **Licensed Product Review**. Sublicensor shall have the right to review the Licensed Products and packaging for the Licensed Products to be sold or offered for sale by Sublicensee prior to first sale of the Licensed Products and thereafter on a quarterly basis. Sublicensor shall have the right to provide suggestions concerning the quality and design of the Licensed Products, including packaging, to be sold or offered for sale by Sublicensee. If Sublicensor determines the quality of Licensed Products and/or packaging on the Licensed Products is unacceptable to Sublicensor, Sublicensor shall work with Sublicensee and offer suggestions to make the Licensed Products suitable and ready for market. Sublicensor and Sublicensee shall be willing to mutually work together in a reasonable manner without undue restriction.

ARTICLE SIX
MARKETING

6.1 **Marketing**. Sublicensee shall mark all Licensed Products made, used or sold under the terms of this Agreement with the following: "Protected by U.S. Patent Nos. 6,689,262, 7,396,441 and 7,670,495. Other Patents Pending."

ARTICLE SEVEN
TERM

7.1 **Term**. The sublicense so granted pursuant to this Agreement shall be effective from the Effective Date and shall terminate with respect to a Licensed Patent on the expiration of the Licensed Patent, subject to Section 7.2 of this Agreement.

7.2 **Termination**. Notwithstanding Section 7.1 of this Agreement, this Agreement shall terminate:

7.2.1 Upon the mutual agreement of the parties;

7.2.2 Upon ten (10) days' written notice from Sublicensor to Sublicensee upon Sublicensee's failure to pay any royalty due and owing Sublicensor;

7.2.3 Immediately if Sublicensee files of a petition of bankruptcy, or a petition or answer seeking reorganization, readjustment or rearrangement of its business or affairs under any law or governmental regulation relating to bankruptcy or insolvency;

7.2.4 Immediately if in Sublicensor's reasonable business judgment Sublicensee undertakes any action that derogates, disparages or impairs any of the Licensed Patents;

7.2.5 Immediately upon the terms of Section 2.1 of this Agreement; or

7.2.6 Upon ninety (90) days' written notice from Sublicensor to Sublicensee if Sublicensee fails to actively sell any Licensed Products or otherwise fails to actively and diligently utilize the sublicense granted by this Agreement.

ARTICLE EIGHT
INFRINGEMENT

8.1 **Notice**. Sublicensee shall inform Sublicensor within thirty (30) days and in writing of any alleged infringement of the Licensed Patents by a third party.

8.2 **Legal Action; Mutual Cooperation**. Sublicensor shall have the right, but shall not be obligated, to prosecute at its own expense any infringement of the Licensed Patents and, in furtherance of such right, Sublicensee hereby agrees that Sublicensor may, if required by law or otherwise, include Sublicensee as a party plaintiff in any such suit, without expense to

Sublicensee. The total cost of any such infringement action commenced or defended solely by Sublicensor shall be borne by Sublicensor, and Sublicensor shall keep any recovery or damages. In the event that any action alleging invalidity, non-enforceability, or non-infringement of any of the Licensed Patents shall be brought by a third party, Sublicensor, at its option, shall have the right to defend such actions.

ARTICLE NINE
INDEMNIFICATION

9.1 Indemnification. Sublicensee shall indemnify, defend, and hold harmless Sublicensor from any and all actions, claims, suits, losses, liabilities, damages, costs, fees, and expenses (including attorney fees) resulting from or arising out of the exercise of the Sublicensee's rights granted under this Agreement. This indemnification shall include, but is not limited to, any and all actions alleging product liability, patent infringement, or other type of intellectual property matter.

ARTICLE TEN
GENERAL TERMS

10.1 Assignment. The rights and sublicenses granted by Sublicensor in this Agreement are personal to Sublicensee and may not be assigned or otherwise transferred without the written consent of Sublicensor. Sublicensor may provide such consent upon request from Sublicensee for any assignment to a third party who is acquiring substantially all of the business assets of Sublicensee, but Sublicensor reserves the right to deny consent if the third party is a competitor of Sublicensor.

10.2 Sublicense. The rights and license granted by Sublicensor in this Agreement may not be sublicensed by Sublicensee without the written consent of Sublicensor.

10.3 Confidentiality. Sublicensor and Sublicensee both agree the terms of this Agreement are confidential and shall not be disclosed to any third party.

10.4 Governing Law. This Agreement shall be construed and enforced according to the laws of the State of Minnesota. Any disputes arising out of, under, or relating to the negotiation, drafting, execution, validity, interpretation, breach, or enforcement of this Agreement shall be venued in the state or federal courts located in Minneapolis, Minnesota.

10.5 Entire Agreement. Sublicensee and Sublicensor acknowledge receipt of this Agreement and agree that with respect to the subject matter hereof this Agreement is the entire agreement of the parties and supersedes any previous oral or written communications or understandings, and that each provision has been given due consideration and accepted without duress.

10.6 Attorneys' Fees. In the event that any proceeding, suit or action is brought by any party under this Agreement to enforce any of its terms, it is agreed that the prevailing party shall be entitled to reasonable attorneys' fees to be fixed by the trial and appellate courts in any such proceeding or as incurred in the collection of any judgment.

10.7 Counterparts. This Agreement may be signed in counterparts by the parties hereto with the same force and effect as if the above parties signed the same original agreement. Facsimile and electronic copies and photocopies of the parties' signatures to this Agreement shall be valid and enforceable to the same extent as original signatures and the parties hereby waive any requirement that original signatures be produced as a condition of proving the validity of or otherwise enforcing this Agreement

IN WITNESS WHEREOF, Sublicensor and Sublicensee have executed this Agreement as of the Effective Date.

Sublicensor:

Roy H. Lecy

Sublicensee:

O2 MARINE TECHNOLOGIES, INC.

By: Dennis Clark
Its: President

PATENT ASSIGNMENT

Electronic Version v1.1
Stylesheet Version v1.1

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	ASSIGNMENT

CONVEYING PARTY DATA

Name	Execution Date
Aqua Innovations, Inc.	10/04/2012

RECEIVING PARTY DATA

Name:	Roy H Lecy
Street Address:	2640 North Saunders Lake Drive
City:	Minnetrista
State/Country:	MINNESOTA
Postal Code:	55364

PROPERTY NUMBERS Total: 3

Property Type	Number
Patent Number:	6689262
Patent Number:	7396441
Patent Number:	7670495

CH $120.00 6689262

CORRESPONDENCE DATA

Fax Number: 6123396591
Correspondence will be sent via US Mail when the fax attempt is unsuccessful.
Phone: 612-337-6100
Email: nathanbrandenburg@siegelbrill.com
Correspondent Name: Nathan M. Brandenburg
Address Line 1: 100 Washington Avenue South
Address Line 2: Suite 1300
Address Line 4: Minneapolis, MINNESOTA 55446

ATTORNEY DOCKET NUMBER:	26141-001
NAME OF SUBMITTER:	Nathan M. Brandenburg
Signature:	/nathanmbrandenburg/

Date:	04/30/2013
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 27
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AMENDMENT TO LICENSE AGREEMENT

THIS AMENDMENT TO LICENSE AGREEMENT (the "Amendment"), is made, entered into and effective as of October 4, 2012, by and between OXYGENATOR WATER TECHNOLOGIES, INC. ("Licensor"), a Minnesota corporation doing business as Water D.O.G. Works, and ROY H. LECY ("Lecy"), and amends certain terms of that certain License Agreement dated July 30, 2008 (the "License Agreement"), entered into by and between Licensor and Aqua Innovations Incorporated ("Aqua"), a Minnesota corporation. Licensor and Lecy may be individually referred to herein as a "party" or collectively as the "parties."

WHEREAS, Licensor, as Licensor, and Aqua, as Licensee, entered into the License Agreement on or about July 30, 2008, a copy of which is attached hereto as Exhibit A; and

WHEREAS, pursuant to an Agreement of Strict Foreclosure dated October 4, 2012, Aqua conveyed all right, title and interest it held in the License Agreement to Lecy; and

WHEREAS, the parties desire to formally amend the License Agreement to reflect Lecy's interest in the Agreement via this Amendment.

NOW THEREFORE, it is hereby agreed as follows:

1. **Incorporation of Recitals**. The recitals set forth above are true and correct and incorporated as if fully stated herein.

2. **Amendment of License Agreement**. All references in the License Agreement to Licensee shall mean Roy H. Lecy and not Aqua. Licensor hereby acknowledges the acquisition by Lecy of all right, title and interest of Aqua in the License Agreement and further acknowledges and agrees that the License Agreement is a binding contract in full force and effect and that Lecy may assign his interest therein at will.

3. **Remaining Terms in Full Force and Effect**. No other terms of the License Agreement or any schedule or exhibit thereto shall be amended or modified in any way and the License Agreement shall remain in full force and effect as amended via this Amendment and the parties hereby reaffirm their respective obligations thereunder.

Oxygenator Water Technologies, Inc.

By: Mark A. Peters
Its: President
10-24-2012

Roy H. Lecy

License Agreement

THIS AGREEMENT ("Agreement") is entered into this 30th day of July, 2008 (the "Effective Date"), by and between Oxygenator Water Technologies, Inc., a Minnesota corporation with offices at 6101 Baker Rd., #206, Minnetonka, Minnesota, 55435 ("Licensor") and Aqua Innovations, Inc. a Minnesota corporation with offices at 6101 Baker Rd., #206, Minnetonka, Minnesota, 55435 ("Licensee", and Licensor and Licensee each a "Party" and together the "Parties"). Initially capitalized terms defined in this Agreement shall have the meaning ascribed to them respectively herein.

WITNESSETH:

LICENSOR owns the technology for which patents have been issued and are pending with respect to electrolytic hydrolysis of water to increase its dissolved oxygen content. A more complete description of said technology, together with a description of the patents issued and currently pending for said technology, is set forth in Article 1 below and in Exhibit "A" attached hereto.

LICENSOR anticipates and intends that it will make additional discoveries and improvements to said technology, some of which may be patentable.

It is further anticipated by the parties that LICENSOR may make improvements to said technology and additional discoveries concerning other applications for said technology.

The parties desire that LICENSOR grant a perpetual, exclusive license to LICENSEE to develop and sell throughout the world certain products utilizing the technology LICENSOR has developed and may in the future develop, all according to the terms and conditions set forth in this Agreement.

The parties further desire that LICENSOR will retain the complete and entire right to develop and sell throughout the world in markets not licensed to LICENSEE hereunder products utilizing the technology LICENSOR has developed and may in the future develop or the technology that LICENSEE may develop in the future, also according to the terms and conditions set forth in this Agreement.

Thus, the parties have agreed to enter into a licensing arrangement by which each party will be entitled to benefit from the other party's patents, technology and know-how concerning electrolytic hydrolysis of water in the sale of products in certain markets.

NOW, THEREFORE, based on the foregoing and the mutual covenants and agreements herein contained, the parties hereby covenant and agree as follows:

EXHIBIT "B"

LICENSEE Markets

All worldwide markets for:

- Waste Water Treatment
- Medical Applications
- Sport Fishing
- Aqua Culture
- Horticulture (consumer and commercial)
- Hydroponics

Markets excluded from license agreement (including but not limited to):

- Water Treatment (all applications except waste water)
- Fermentation
- Desalination
- Human Nutrition
- Animal Nutrition

ARTICLE 1
DEFINITIONS

When used in this Agreement, the following terms have the meanings set forth below unless a different and common meaning of the term is clearly indicated by the context, and variants and derivatives of the following terms shall have correlative meanings:

"*Agreement*" has the meaning set forth in the preamble.

"***LICENSOR Documents"*** has the meaning set forth in Section 2.6.

"***LICENSOR Improvements***" means all developments LICENSOR may make in the LICENSOR Technology or the LICENSEE Technology prior to the termination of this Agreement, whether or not patentable, and which are invented, developed, discovered or otherwise acquired by LICENSOR and which LICENSOR may lawfully communicate to LICENSEE.

"***LICENSOR Markets***" means all uses for the LICENSOR Technology and the LICENSEE Technology other than in the LICENSEE Markets.

"***LICENSOR Patents***" means all of LICENSOR's patents (whether issued to LICENSOR or controlled by license rights or otherwise and whether such rights are held alone or jointly with others, and patents pending now, or during the term of this Agreement, issued to LICENSOR (by any country) relating to the LICENSOR Technology, including, but not limited to, those patents and those patents pending described on Exhibit A and any continuations, continuations-in-part, divisions, registrations, confirmations, reissues, renewals or extensions of term thereof.

"***LICENSOR Products***" means any product manufactured and/or sold or distributed by LICENSOR or a sub licensee of LICENSOR under any claim contained in the LICENSEE Patents.

"***LICENSOR Property***" means LICENSOR Patents, LICENSOR Improvements and LICENSOR Technology.

"***LICENSOR Technology***" means LICENSOR's unpatented technology and information now existing and relating to, and embodying LICENSOR's experience in electrolytic hydrolysis of water. LICENSOR Technology shall include the technical information in all current and future manuals, formulae, specifications, test data and procedures, flow charts, apparatus plans, drawings, designs and other information actually communicated by LICENSOR to LICENSEE during the term of this Agreement, whether contained in documentary form, electronic medium or communicated as a result of LICENSOR imparting the same directly or giving LICENSEE access to any of LICENSOR's production facilities.

"***Effective Date***" has the meaning set forth in the preamble.

"***LICENSEE Documents"*** has the meaning set forth in Section 2.7.

"***LICENSEE Improvements***" means all developments LICENSEE may make in the LICENSOR Technology or the LICENSEE Technology prior to the termination of this Agreement, whether or not patentable and which are invented, developed, discovered or otherwise acquired by LICENSEE and which LICENSEE may lawfully communicate to LICENSOR.

"***LICENSEE Markets***" means those markets for Licensee Products as are described in Exhibit B attached hereto.

"***LICENSEE Patents***" means all of LICENSEE's patents (whether issued to LICENSEE or controlled by license rights or otherwise and whether such rights are held alone or jointly with others) which may after the effective date of this Agreement be issued (by any country) relating to electrolytic hydrolysis of water and any continuations, continuations-in-part, divisions, registrations, confirmations, reissues, renewals or extensions of term thereof.

"***LICENSEE Products***" means any product manufactured and/or sold or distributed to any party other than LICENSOR by LICENSEE or a sublicense of LICENSEE in conformity with the terms of this Agreement, including, but not limited to, any product which is based on any claim or thing contained in any LICENSOR Property.

"***LICENSEE Property***" means LICENSEE Patents, LICENSEE Improvements and LICENSEE Technology.

"***LICENSEE Technology***" means LICENSEE's unpatented technology and information which LICENSEE may develop relating to, and embodying LICENSEE's experience in, the manufacturing, the processing, quality control, and sale of the LICENSEE Products. LICENSEE Technology shall include the technical information in all manuals, formulae, specifications, test data and procedures, flow charts, apparatus plans, drawings, designs and other information actually communicated by LICENSEE to LICENSOR during the term of this Agreement, whether contained in documentary form, electronic medium or communicated as a result of LICENSEE imparting the same directly or giving LICENSOR access to any of LICENSEE's production facilities.

"***Territory***" means the world.

ARTICLE 2
MARKETS AND LICENSING

2.1. Exclusive Markets. The parties agree that unless properly terminated by LICENSOR pursuant to Section 5.1 below, LICENSEE will have the exclusive right to exploit the LICENSOR Property and the LICENSEE Property in the manufacture, use and sale or other distribution of LICENSEE Products in the LICENSEE Markets in the Territory. The parties further agree that LICENSOR will have the exclusive right to exploit the LICENSOR Property and the LICENSEE Property in the manufacture, use and sale or other distribution of LICENSOR Products in the LICENSOR Markets in the Territory. LICENSEE may not, directly or indirectly, distribute in any manner any product which competes with the LICENSEE Products in any manner nor may LICENSEE assist or have any interest in any third party distributing any such products through licensing or assignment of technology to any such third party or by any other means.

2.2. Exclusive License to LICENSEE. Subject to the terms and conditions of this Agreement, LICENSOR hereby confers upon LICENSEE the sole and exclusive license, with the right of sublicense, under the LICENSOR Property, to make, have made, use and sell the LICENSEE Products in the LICENSEE Markets in the Territory and to prevent infringement of the LICENSOR Patents, and to prevent unauthorized use and disclosure of the LICENSOR Technology in connection therewith. No license is conferred hereby to make, have made, use and sell articles which are not LICENSEE Products.

2.3. Exclusive License to LICENSOR. Subject to the terms and conditions of this Agreement, LICENSEE hereby confers upon LICENSOR the sole and exclusive, royalty-free license, with the right of sublicense, under the LICENSEE Property, to make, have made, use and sell the LICENSOR Products in the LICENSOR Markets in the Territory and to prevent infringement of the LICENSEE Patents, and to prevent unauthorized use and disclosure of the LICENSEE Technology in connection therewith. No license is conferred hereby to make, have made, use and sell articles which are not LICENSOR Products.

2.4. Product Markings. The Parties shall insure that all LICENSOR Products and all LICENSEE Products are marked with any applicable patent number and all labeling and other product information shall be marked in such manner as to conform with the patent laws and practices of the country of sale.

2.5 Transfer of Technology by LICENSOR. As promptly as practicable after the execution of this Agreement, LICENSOR shall deliver to LICENSEE all information concerning the LICENSOR Property. LICENSOR also promptly shall deliver to LICENSEE all future information it acquires concerning the LICENSOR Property. All documentary information so delivered or any documentary information following non-documentary disclosure by LICENSOR, shall be referred to as "LICENSOR Documents". LICENSEE shall receive, use, maintain, restrict access to or copying of, and safeguard the LICENSOR Documents in such manner as to maximize the value of the LICENSOR Patents, the LICENSOR Technology and the LICENSOR Improvements; without limiting the generality of the foregoing, LICENSEE shall, and shall cause its employees and

representatives to, use reasonable care to prevent unauthorized access to, copying, use, publication, disclosure or other dissemination of the LICENSOR Documents. Upon 10 days advance notice and at reasonable times, LICENSOR shall permit LICENSEE access to its technical personnel at its offices or at such locations as is mutually agreed upon by the Parties. During such visits, technically competent personnel will be provided by LICENSOR to answer fully such questions as LICENSEE may have with a view to transferring the LICENSOR Property. Nothing in this Section 2.6 shall require LICENSOR to disclose to LICENSEE any technological information which it does not own or that is otherwise subject to restrictions on use or disclosure.

2.6. Transfer of Technology by LICENSEE. As promptly as practicable after LICENSEE develops, discovers or otherwise comes into possession of LICENSEE Patents, LICENSEE Improvements and/or LICENSEE Technology, LICENSEE shall deliver to LICENSOR all information concerning same. All documentary information so delivered or any documentary information following non-documentary disclosure by LICENSEE, shall be referred to as "LICENSEE Documents." LICENSOR shall receive, use, maintain, restrict access to or copying of, and safeguard the LICENSEE Documents in such manner as to maximize the value of the LICENSEE Patents, the LICENSEE Technology and the LICENSEE Improvements; without limiting the generality of the foregoing, LICENSOR shall, and shall cause its employees and representatives to, use reasonable care to prevent unauthorized access to, copying, use, publication, disclosure or other dissemination of the LICENSEE Documents. Upon 10 days advance notice and at reasonable times, LICENSEE shall permit LICENSOR access to its technical personnel at its offices or at such locations as is mutually agreed upon by the Parties. During such visits, technically competent personnel will be provided by LICENSEE to answer fully such questions as LICENSOR may have with a view to transferring to LICENSOR the LICENSEE Property. Nothing in this Section 2.7 shall require LICENSEE to disclose to LICENSOR any technological information which it does not own or that is otherwise subject to restrictions on use or disclosure.

2.7. Further Prosecution of Patents. LICENSOR will continue with the prompt prosecution of all pending patent applications filed by LICENSOR as detailed on Schedule "A", so long as it is commercially reasonable to do so, and LICENSOR will periodically advise LICENSEE of the status of such prosecutions. As soon as practical, the Parties will confer to determine the countries for which the Parties desire protection for the LICENSOR Patents. In the event that LICENSEE files an application for a patent(s) covering electrolytic hydrolysis of water, LICENSEE will periodically advise LICENSOR of the status of the prosecution of any such patent. As soon as practical after any such application by LICENSEE, the Parties will confer to determine the countries for which the Parties desire protection for the LICENSEE Patents. From the date of this Agreement, all expenses incurred in filing for and maintaining protection in those countries mutually agreed upon (other than expenses of prosecuting the original patent application in the first jurisdiction, which will be the responsibility of the Party filing the patent application) will be shared equally by the Parties. Either Party may seek protection in any country not mutually agreed upon by paying the full amount of the cost thereof. A party seeking such additional protection will receive the full cooperation of the other Party (other than in paying the expenses thereof) in protecting all patents in any such other country.

2.8. Additional Covenants. Each of LICENSOR and LICENSEE shall faithfully comply with their respective obligations under this Agreement and shall incorporate all terms and conditions required by this Agreement in any contracts with third parties to whom access to the LICENSOR Property or the LICENSEE Property, as the case may be, may (but only in accordance with this Agreement) be given. Each of LICENSOR and LICENSEE shall indemnify and hold harmless the other Party and its successors and assigns from any injury, loss, or damage of any kind or nature, or any other liability sought to be imposed on such Party, and arising out of or in connection with or resulting from the marketing, sale or use of the imdemnifying Party's product(s), including any advertising or other promotional activities related thereto.

2.9. Infringement Actions. Neither LICENSOR nor LICENSEE will have any responsibility to the other Party for any damage or expense incurred by such other Party which arises from any action, claim or cause of action brought by any person as the result of any alleged patent infringement or trade secret misappropriation by reason of such other Party's manufacture, use or sale of any product under any of the licenses conferred hereby.

2.10. LICENSEE's Rights in Event of Third Party Infringement. LICENSEE shall have the right, in LICENSOR's name (if required by law, otherwise, in LICENSEE's name) but at LICENSEE's sole expense, to sue third parties in the LICENSEE Markets for infringements of the LICENSOR Patents and misappropriation of the LICENSOR Technology and unpatented LICENSOR Improvements, and LICENSOR shall, but at LICENSEE's expense for LICENSOR's direct associated expenses, fully and promptly cooperate and assist LICENSEE in connection with any such suit. LICENSEE shall promptly reimburse LICENSOR for said suit-associated direct expenses upon presentation of LICENSOR's itemized statement therefor. LICENSOR may, if it so elects, join in any such suit as a plaintiff. All damages, awards or settlement proceeds in such suit shall be LICENSEE's. If LICENSEE, after notice from LICENSOR of an alleged infringement or misappropriation, shall within 90 days fail to institute suit, LICENSOR, in its own name (or, if required by law, in its and LICENSEE's name) and at its own expense, may sue therefore, and LICENSEE shall, but at LICENSOR's expense for LICENSEE's direct associated expenses, fully and promptly cooperate and assist LICENSOR in connection with any such suit. LICENSOR shall promptly reimburse LICENSEE for said suit-associated direct expenses upon presentation of LICENSEE's itemized statement therefor. All damages, awards or settlement proceeds in such suit shall be LICENSOR's.

2.11. LICENSOR's Rights in Event of Third Party Infringement. LICENSOR shall have the right, in LICENSEE's name (if required by law, otherwise, in LICENSOR's name) but at LICENSOR's sole expense, to sue third parties in the LICENSOR Markets for infringements of the LICENSEE Patents and misappropriation of the LICENSEE Technology and unpatented LICENSEE Improvements, and LICENSEE shall, but at LICENSOR's expense for LICENSEE's direct associated expenses, fully and promptly cooperate and assist LICENSOR in connection with any such suit. LICENSEE may, if it so elects, join in any such suit as a plaintiff. LICENSOR shall promptly reimburse LICENSEE for said suit-associated direct expenses upon presentation of LICENSEE's itemized

statement therefor. All damages, awards or settlement proceeds in such suit shall be LICENSOR's. If LICENSOR, after notice from LICENSEE of an alleged infringement or misappropriation, shall within 90 days fail to institute suit, LICENSEE, in its own name (or, if required by law, in its and LICENSOR's name) and at its own expense, may sue therefore, and LICENSOR shall, but at LICENSEE's expense for LICENSOR's direct associated expenses, fully and promptly cooperate and assist LICENSEE in connection with any such suit. LICENSEE shall promptly reimburse LICENSOR for said suit-associated direct expenses upon presentation of LICENSOR's itemized statement therefor. All damages, awards or settlement proceeds in such suit shall be LICENSEE's.

2.12. LICENSEE Royalty Payment. None. License is granted without cost to LICENSEE.

ARTICLE 3
INDEMNIFICATION

3.1. Indemnification by LICENSEE. LICENSEE shall indemnify and hold LICENSOR and its successors and assigns harmless from any injury, loss, or damage of any kind or nature, or any other liability sought to be imposed on LICENSOR arising out of or in connection with or resulting from the marketing, sale or use of the LICENSEE Products, including any advertising or other promotional activities related thereto. LICENSOR shall be an added insured party to LICENSEE's product liability insurance, which shall have coverage limits of at least two million dollars ($2,000,000) per incident and which LICENSEE shall procure and have in place no later than the date on which LICENSEE first makes a delivery of any of the LICENSEE Products. Such policy of insurance shall provide that it may not be cancelled unless LICENSOR is provided at least thirty (30) days advance written notice.

3.2. Indemnification by LICENSOR. LICENSOR shall indemnify and hold LICENSEE and its successors and assigns harmless from any injury, loss, or damage of any kind or nature, or any other liability sought to be imposed on LICENSEE arising out of or in connection with or resulting from the marketing, sale or use of the LICENSOR Products, including any advertising or other promotional activities related thereto. At such time, if any, as LICENSOR shall sell LICENSOR Products, LICENSOR shall add LICENSEE as an added insured party to LICENSOR's product liability insurance, which shall have coverage limits of at least two million dollars ($2,000,000) per incident and which LICENSOR shall procure and have in place no later than the date on which LICENSOR first makes a delivery of any of the LICENSOR Products. Such policy of insurance shall provide that it may not be cancelled unless LICENSEE is provided at least thirty (30) days advance written notice.

ARTICLE 4
CONFIDENTIALITY

4.1. Restrictions on Use and Disclosure of LICENSOR Property by LICENSEE. LICENSEE shall use the LICENSOR Property in confidence and shall not

disclose same to its employees to whom access may be given in accordance with this Agreement until each such employee shall have previously agreed not to disclose such information. Restrictions on use and disclosure of any portion thereof shall terminate: (a) if that portion is, or becomes, generally known within the related trade or industry through no default of LICENSEE, or (b) upon the expiration of the obligation of LICENSEE under this Agreement to pay royalties to LICENSOR.

4.2. Restrictions on Use and Disclosure of LICENSEE Property by LICENSOR. LICENSOR shall use the LICENSEE Property in confidence and shall not disclose same to its employees to whom access may be given in accordance with this Agreement until each such employee shall have previously agreed not to disclose such information. Restrictions on use and disclosure of any portion thereof shall terminate if that portion is, or becomes, generally known within the related trade or industry through no default of LICENSOR.

4.3. Employees; Third Parties Etc. In order to faithfully perform their respective obligations under sections 4.1 and 4.2, the Parties shall limit access to the other Party's Property to only those of its officers, employees and agents who shall have a need to receive or have access to that portion, and then only for the purposes of the practice under the licenses conferred by this Agreement. Each Party will require any third party, to whom access may be authorized under this Agreement, to execute an appropriate confidentiality agreement.

4.4. Authorized Required Disclosures. Nothing in this Article 4 shall prevent a Party: (a) from complying (but only to the narrowest extent required by law and regulation and with due notice on any submissions to governmental agencies of the confidential or proprietary status of the information with a view toward restricting access to, and use or disclosure by, third parties) with reasonable requirements of governmental agencies to disclose information in order to receive legally required consents or permissions to manufacture or sell that Party's Products; or (b) from disclosing information under court order, but only after having made all reasonable efforts to secure the court's order to (i) limit production, use and disclosure of said information for the purposes of the case and to the narrowest class of disclosures practicable under the circumstances and (ii) hold all proceedings in camera with a sealed record.

ARTICLE 5
RESOLUTION OF DISPUTES

All claims, disputes and other matters in question arising out of, or relating to, this Agreement or the performance thereof shall be submitted to, and determined by, arbitration if good faith negotiations between the parties do not resolve such claim, dispute or other matter within 60 days. Such arbitration shall proceed in accordance with the Commercial Arbitration Rules of the American Arbitration Association then pertaining (the "Rules"), insofar as such Rules are not inconsistent with the provisions expressly set forth in this Agreement, unless the parties mutually agree otherwise, and pursuant to the following procedures:

(a) Notice of the demand for arbitration shall be filed in writing with the other Member and with the American Arbitration Association. Each Member shall appoint an arbitrator, and those party-appointed arbitrators shall appoint a third neutral arbitrator within 10 days. If the party-appointed arbitrators fail to appoint a third, neutral arbitrator within 10 days, such third, neutral arbitrator shall be appointed by the American Arbitration Association in accordance with the Rules. A determination by a majority of the panel shall be binding.

(b) Reasonable discovery shall be allowed in arbitration.

(c) All proceedings before the arbitrators shall be held in Minneapolis, Minnesota. The governing law shall be as specified in Section 8.1 below.

(d) The costs and fees of the arbitration, including attorneys' fees, shall be allocated by the arbitrators.

(e) The award rendered by the arbitrators shall be final and judgment may be entered in accordance with applicable law and in any court having jurisdiction thereof.

ARTICLE 6
NOTICES

6.1. Notices. All communications, demands, notices or objections required or permitted to be given or served under this Agreement shall be in writing and shall be deemed to have been duly given or made only if delivered in person, deposited in the United States mail, postage prepaid, for mailing by certified or registered mail, return receipt requested, or delivered by prepaid overnight courier service, addressed to the appropriate party as follows:

If to LICENSOR: Richard Disrud, COO
Aqua Innovations, Inc.
6101 Baker Rd., #206
Minnetonka, Minnesota 55435

If to LICENSEE: Jeffrey Brink, CEO
Oxygenator Water Technology, Inc.
6101 Baker Rd., #206
Minnetonka, Minnesota 55435

Either party may change its address by giving notice in writing, stating the new address, to the other Party as provided in the foregoing manner. Commencing on the tenth (10th) day after the giving of such notice, such newly designated address shall be such Party's address for the purpose of all communications, demands, notices or objections required or permitted to be given or served under this Agreement.

ARTICLE 7
MISCELLANEOUS

7.1. Governing Law; Court Proceedings. The validity, performance, and all matters relating to the interpretation and effect of this Agreement shall be governed by the internal law in effect in the State of Minnesota without regard to principles of law (such as "conflicts of law") that might make the law of some other jurisdiction applicable. Without limiting the terms set forth in Article 6 with respect to the resolution of disputes, each Party agrees to the exclusive and irrevocable jurisdiction of the federal and state courts of Minnesota for any claim, action or cause of action arising out of or in any way related to this Agreement which may be brought in a court of law and both parties agree that personal service from any such court may be effectively served upon a party at the respective addresses set forth in Section 7.1.

7.2. Exhibits. Exhibits, schedules and annexes referred to in this Agreement and attached hereto are incorporated herein in full by this reference as if each of such exhibits, schedules or annexes were set forth in the body of this Agreement and duly executed by the parties hereto.

7.3. Additional Documents and Acts. Each party agrees that it will use all reasonable efforts to take, or cause to be taken, all actions and to do, or cause to be done, all things necessary, proper or advisable, including, but not limited to, the execution of additional documents and instruments, to consummate, make effective and carry out the transactions contemplated by this Agreement.

7.4. Amendment, Modification or Waiver. No amendment, modification or waiver of any condition, provision or term of this Agreement shall be valid or of any effect unless made in writing, signed by the party or parties to be bound or its duly authorized representative and specifying with particularity the nature and extent of such amendment, modification or waiver. Any waiver by any party of a default of another party shall not affect or impair any right arising from any subsequent default.

7.5. Severable Provisions. Whenever possible, each provision of this Agreement will be interpreted in such manner as to be effective and valid under applicable law, but if any provision of this Agreement is held to be invalid, illegal or unenforceable under any applicable law or rule in any jurisdiction, such provision will be ineffective only to the extent of such invalidity, illegality, or unenforceability in such jurisdiction, without invalidating the remainder of this Agreement in such jurisdiction or any provision hereof in any other jurisdiction.

7.6. Entire Agreement. This Agreement contains the entire understanding of the parties hereto in respect of the transactions contemplated hereby and supersedes all prior agreements and understandings between the parties with respect to such subject matter.

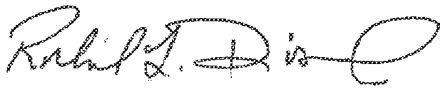
7.7. Captions, Headings, Titles or References to Gender. All captions, headings

or titles in the paragraphs or sections of this Agreement are inserted for convenience of reference only and shall not constitute a part of this Agreement or as a limitation of the scope of the particular paragraphs or sections to which they apply. Where appropriate, the masculine gender may be read as the feminine gender or the neuter gender, the feminine gender may be read as the masculine gender or the neuter gender and the neuter gender may be read as the masculine gender or the feminine gender.

7.8. Counterparts. This Agreement may be executed in two (2) or more counterparts, each of which shall be considered one and the same Agreement and shall become effective when one or more counterparts have been signed by each of the parties and delivered to the other parties.

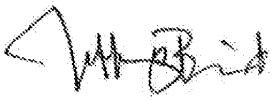
IN WITNESS WHEREOF, the parties have executed this Agreement on the date first written above.

AQUA INNOVATIONS, INC.



Dick Disrud its COO

OXYGENATOR WATER TECHNOLOGIES, INC.



Jeff Brink its CEO

EXHIBIT "A"

DESCRIPTION OF LICENSOR PATENTS AND PATENTS PENDING

United States Patent Number: US 6,689,262 B2
Date of Patent: February 10, 2004
Name: Microbubbles of Oxygen
Application Number: 10/372,017

An oxygen emitter which is an electrolytic cell. When the anode and cathode are separated by a critical distance, very small microbubbles and nanobubbles of oxygen are generated. The hydrogen forms bubbles at the cathode, which bubbles rise to the surface. The very small oxygen bubbles remain in suspension, forming a solution supersatured in oxygen.

United States Patent Number: US 7,396,441 B2
Publication Date: July 8, 2008
Name: Flow-Thru Oxygenator
Application Number: 10/732,326

An oxygen emitter which is an electrolytic cell. When the anode and cathode are separated by a critical distance, very small microbubbles and nanobubbles of oxygen are generated. The hydrogen forms bubbles at the cathode, which bubbles rise to the surface. The very small oxygen bubbles remain in suspension, forming a solution supersatured in oxygen. A flow-through model for oxygenating flowing water. The use of supersaturated water for enhancing the growth of plants. Method of applying supersaturated water to plants manually, by drip irrigation or in hydroponic culture. The treatment of waste water by raising the dissolved oxygen with the use of oxygen emitter.

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12/623,431 FLOW-THROUGH OXYGENATOR

Select New Case | Application Data | Transaction History | Image File Wrapper | Patent Term Adjustments | Continuity Data | Fees | Published Documents | Address & Attorney/Agent

Bibliographic Data

Application Number:	12/623,431	Customer Number:	
Filing or 371 (c) Date:	01-31-2008	Status:	Patented Case
Application Type:	Utility	Status Date:	02-10-2010
Examiner Name:	ALLEN, CAMERON J	Location:	ELECTRONIC
Group Art Unit:	1797	Location Date:	
Confirmation Number:	7381	Earliest Publication No:	US 2008-0179259 A1
Attorney Docket Number:	40S6.02US03	Earliest Publication Date:	07-31-2008
Class / Subclass:	210/748	Patent Number:	7,670,495
First Named Inventor:	James Andrew Senkiw , Minneapolis, MN (US)	Issue Date of Patent:	03-02-2010

Title of Invention: FLOW-THROUGH OXYGENATOR

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THIS PATENT ISSUED 3/2/2010. IN DISCUSSION WITH PAUL HANN, IT GIVES US BROAD COVERAGE.

United States Patent **7,670,495**
Senkiw **March 2, 2010**

Flow-through oxygenator

Abstract

An oxygen emitter which is an electrolytic cell is disclosed. When the anode and cathode are separated by a critical distance, very small microbubbles and nanobubbles of oxygen are generated. The very small oxygen bubbles remain in suspension, forming a solution supersaturated in oxygen. A flow-through model for oxygenating flowing water is disclosed. The use of supersaturated water for enhancing the growth of plants is disclosed. Methods for applying supersaturated water to plants manually, by drip irrigation or in hydroponic culture are described. The treatment of waste water by raising the dissolved oxygen with the use of an oxygen emitter is disclosed.

Inventors: **Senkiw; James Andrew** (Minneapolis, MN)
Assignee: **Oxygenator Water Technologies, Inc.** (Minnetonka, MN)
Appl. No.: **12/023,431**
Filed: **January 31, 2008**

Related U.S. Patent Documents

Application Number	Filing Date	Patent Number	Issue Date
10732326	Dec., 2003	7396441	
10372017	Feb., 2004	6689262	
60358534	Feb., 2002		

Current U.S. Class: 204/232; 204/245; 205/628; 210/243; 210/600
Current International Class: C02F 1/48 (20060101); C02F 1/00 (20060101); C25B 1/02 (20060101); C25B 1/04 (20060101)
Field of Search: 210/748,600,243 204/278,242,243,275.1,232,286.1,554,660 205/633-638

References Cited [Referenced By]

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1 522 188	Aug., 1978	GB
WO 99/39561	Aug., 1999	WO
WO 01/89997	Nov., 2001	WO
WO 03/072507	Sep., 2003	WO

Other References

Mohyuddin Mirza et al., "Effect of Oxygenated Water on the Growth & Biomass Development of Seedless Cucumbers and Tomato Seedlings under Greenhouse Conditions," Seair Diffusion Systems, 2003, 5 pages, www.seair.ca. cited by other.

Primary Examiner: Griffin; Walter D
Assistant Examiner: Allen; Cameron J
Attorney, Agent or Firm: Patterson, Thuente, Skaar & Christensen, P.A.

Parent Case Text

RELATED APPLICATIONS

This application is a division of application Ser. No. 10/732,326 filed Dec. 10, 2003, which in turn is a continuation-in-part of application Ser. No. 10/372,017, filed Feb. 21, 2003, now U.S. Pat. No. 6,689,262, which claims the benefit of U.S. Provisional Application No. 60/358,534, filed Feb. 22, 2002, each of which is hereby fully incorporated herein by reference.

Claims

The invention claimed is:

1. A method for treating waste water comprising; providing a flow-through oxygenator comprising an emitter for electrolytic generation of microbubbles of oxygen comprising an anode separated at a critical distance from a cathode and a power source all in electrical communication with each other, placing the emitter within a conduit; and passing waste water through the conduit.

2. An emitter for electrolytic generation of microbubbles of oxygen in an aqueous medium comprising: an anode separated at a critical distance from a cathode, a nonconductive spacer maintaining the separation of the anode and cathode, the nonconductive spacer having a spacer thickness between 0.005 to 0.050 inches such that the critical distance is less than 0.060 inches and a power source all in electrical communication with each other, wherein the critical distance results in the formation of oxygen bubbles having a bubble diameter less than 0.0006 inches, said oxygen bubbles being incapable of breading the surface tension of the aqueous medium such that said aqueous medium is supersaturated with oxygen.

3. The emitter of claim 2, wherein the anode is a metal or a metallic oxide or a combination of a metal and a metallic oxide.

4. The emitter of claim 2, wherein the anode is platinum and iridium oxide on a support.

5. The emitter of claim 2, wherein the cathode is a metal or metallic oxide or a combination of a metal and a metallic oxide.

6. The emitter of claim 2, wherein the critical distance is 0.005 to 0.060 inches.

7. The emitter of claim 2, comprising a plurality of anodes separated at the critical distance from a plurality of cathodes.

8. A method for oxygenating a non-native habitat for temporarily keeping aquatic animals, comprising: inserting the emitter of claim 2 into the aqueous medium, the non-native habitat comprising an aquarium, a bait bucket or a live well.

9. A method for lowering the biologic oxygen demand of polluted water comprising: passing the polluted water through a vessel containing the emitter of claim 2.

10. A supersaturated aqueous product formed with the emitter of claim 2, the supersaturated aqueous product having an approximately neutral pH.

11. The emitter of claim 2, further comprising a timer control.

12. The emitter of claim 2, wherein the anode and cathode are arranged such that the emitter assumes a funnel or pyramidal shaped emitter.

Description

FIELD OF THE INVENTION

This invention relates to the electrolytic generation of microbubbles of oxygen for increasing the oxygen content of flowing water. This invention also relates to the use of superoxygenated water to enhance the growth and yield of plants. The flow-through model is useful for oxygenating water for hydroponic plant culture, drip irrigation and waste water treatment.

BACKGROUND OF THE INVENTION

Many benefits may be obtained through raising the oxygen content of aqueous media. Efforts have been made to achieve higher saturated or supersaturated oxygen levels for applications such as the improvement of water quality in ponds, lakes, marshes and reservoirs, the detoxification of contaminated water, culture of fish, shrimp and other aquatic animals, biological culture and hydroponic culture. For example, fish held in a limited environment such as an aquarium, a bait bucket or a live hold tank may quickly use up the dissolved oxygen in the course of normal respiration and are then subject to hypoxic stress, which can lead to death. A similar effect is seen in cell cultures, where the respiring cells would benefit from higher oxygen content of the medium. Organic pollutants from agricultural, municipal and industrial facilities spread through the ground and surface water and adversely affect life forms. Many pollutants are toxic, carcinogenic or mutagenic. Decomposition of these pollutants is facilitated by oxygen, both by direct chemical detoxifying reactions or by stimulating the growth of detoxifying microflora. Contaminated water is described as having an increased biological oxygen demand (BOD) and water treatment is aimed at decreasing the BOD so as to make more oxygen available for fish and other life forms.

The most common method of increasing the oxygen content of a medium is by sparging with air or oxygen. While this is a simple method, the resulting large bubbles produced simply break the surface and are discharged into the atmosphere. Attempts have been made to reduce the size of the bubbles in order to facilitate oxygen transfer by increasing the total surface area of the oxygen bubbles. U.S. Pat. No. 5,534,143 discloses a microbubble generator that achieves a bubble size of about 0.10 millimeters to about 3 millimeters in diameter. U.S. Pat. No. 6,394,429 ("the '429 patent") discloses a device for producing microbubbles, ranging in size from 0.1 to 100 microns in diameter, by forcing air into the fluid at high pressure through a small orifice.

When the object of generating bubbles is to oxygenate the water, either air, with an oxygen content of about 21%, or pure oxygen may be used. The production of oxygen and hydrogen by the electrolysis of water is well known. A current is applied across an anode and a cathode which are immersed in an aqueous medium. The current may be a direct current from a battery or an AC/DC converter from a line. Hydrogen gas is produced at the cathode and oxygen gas is produced at the anode. The reactions are:

TABLE-US-00001 AT THE CATHODE: 4H.sub.2O + 4e.sup.- .fwdarw. 4OH.sup.- + 2H.sub.2 AT THE ANODE: 2H.sub.2O .fwdarw. O.sub.2 + 4H.sup.+ + 4e.sup.- NET REACTION: 6H.sub.2O .fwdarw. 4OH.sup.- + 4H.sup.+ ++ 2H.sub.2 + O.sub.2

286 kilojoules of energy is required to generate one mole of oxygen.

The gasses form bubbles which rise to the surface of the fluid and may be collected. Either the oxygen or the hydrogen may be collected for various uses. The "electrolytic water" surrounding the anode becomes acidic while the electrolytic water surrounding the cathode becomes basic. Therefore, the electrodes tend to foul or pit and have a limited life in these corrosive environments.

Many cathodes and anodes are commercially available. U.S. Pat. No. 5,982,609 discloses cathodes comprising a metal or metallic oxide of at least one metal selected from the group consisting of ruthenium, iridium, nickel, iron, rhodium, rhenium, cobalt, tungsten, manganese, tantalum, molybdenum, lead, titanium, platinum, palladium and osmium. Anodes are formed from the same metallic oxides or metals as cathodes. Electrodes may also be formed from alloys of the above metals or metals and oxides co-deposited on a substrate. The cathode and anodes may be formed on any convenient support in any desired shape or size. It is possible to use the same materials or different materials for both electrodes. The choice is determined according to the uses. Platinum and iron alloys ("stainless steel") are often preferred materials due to their inherent resistance to the corrosive electrolytic water. An especially preferred anode disclosed in U.S. Pat. No. 4,252,856 comprises vacuum deposited iridium oxide.

Holding vessels for live animals generally have a high population of animals which use up the available oxygen rapidly. Pumps to supply oxygen have high power requirements and the noise and bubbling may further stress the animals. The available electrolytic generators likewise have high power requirements and additionally run at high voltages and produce acidic and basic water which are detrimental to live animals. Many of the uses of oxygenators, such as keeping bait or caught fish alive, would benefit from portable devices that did not require a source of high power. The need remains for quiet, portable, low voltage means to oxygenate water.

It has also been known that plant roots are healthier when oxygenated water is applied. It is thought that oxygen inhibits the growth of deleterious fungi. The water sparged with air as in the '429 patent was shown to increase the biomass of hydroponically grown cucumbers and tomatoes by about 15%.

The need remains for oxygenator models suitable to be placed in-line in water distribution devices so as to be applied to field as well as hydroponic culture.

SUMMARY OF THE INVENTION

This invention provides an oxygen emitter which is an electrolytic cell which generates very small microbubbles and nanobubbles of oxygen in an aqueous medium, which bubbles are too small to break the surface tension of the medium, resulting in a medium supersaturated with oxygen.

The electrodes may be a metal or oxide of at least one metal selected from the group consisting of ruthenium, iridium, nickel, iron, rhodium, rhenium, cobalt, tungsten, manganese, tantalum, molybdenum, lead, titanium, platinum, palladium and osmium or oxides thereof. The electrodes may be formed into open grids or may be closed surfaces. The most preferred cathode is a stainless steel mesh. The most preferred mesh is a 1/16 inch grid. The most preferred anode is platinum and iridium oxide on a support. A preferred support is titanium.

In order to form microbubbles and nanobubbles, the anode and cathode are separated by a critical distance. The critical distance ranges from 0.005 inches to 0.140 inches. The preferred critical distance is from 0.045 to 0.060 inches.

Models of different size are provided to be applicable to various volumes of aqueous medium to be oxygenated. The public is directed to choose the applicable model based on volume and power requirements of projected use. Those models with low voltage requirements are especially suited to oxygenating water in which animals are to be held.

Controls are provided to regulate the current and timing of electrolysis.

A flow-through model is provided which may be connected in-line to a watering hose or to a hydroponic circulating system. The flow-through model can be formed into a tube with triangular cross-section. In this model, the anode is placed toward the outside of the tube and the cathode is placed on the inside, contacting the water flow. Alternatively, the anodes and cathodes may be in plates parallel to the long axis of the tube, or may be plates in a wafer stack. Alternately, the electrodes may be placed in a side tube ("T" model) out of the direct flow of water. Protocols are provided to produce superoxygenated water at the desired flow rate and at the desired power usage. Controls are inserted to activate electrolysis when water is flowing and deactivate electrolysis at rest.

This invention includes a method to promote growth and increase yield of plants by application of superoxygenated water. The water treated with the emitter of this invention is one example of superoxygenated water. Plants may be grown in hydroponic culture or in soil. The use of the flow-through model for drip irrigation of crops and waste water treatment is disclosed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is the O.sub.2 emitter of the invention.

FIG. 2 is an assembled device.

FIG. 3 is a diagram of the electronic controls of the O.sub.2 emitter.

FIG. 4 shows a funnel or pyramid variation of the O.sub.2 emitter.

FIG. 5 shows a multilayer sandwich O.sub.2 emitter.

FIG. 6 shows the yield of tomato plants watered with superoxygenated water.

FIG. 7 shows an oxygenation chamber suitable for flow-through applications. FIG. 7A is a cross section showing arrangement of three plate electrodes. FIG. 7B is a longitudinal section showing the points of connection to the power source.

FIG. 8 is a graph showing the oxygenation of waste water.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

For the purpose of describing the present invention, the following terms have these meanings:

"Critical distance" means the distance separating the anode and cathode at which evolved oxygen forms microbubbles and nanobubbles.

"Critical distance" means the distance separating the anode and cathode at which evolved oxygen forms microbubbles and nanobubbles.

"O.sub.2 emitter" means a cell comprised of at least one anode and at least one cathode separated by the critical distance.

"Metal" means a metal or an alloy of one or more metals.

"Microbubble" means a bubble with a diameter less than 50 microns.

"Nanobubble" means a bubble with a diameter less than that necessary to break the surface tension of water. Nanobubbles remain suspended in the water, giving the water an opalescent or milky appearance.

"Supersaturated" means oxygen at a higher concentration than normal calculated oxygen solubility at a particular temperature and pressure.

"Superoxygenated water" means water with an oxygen content at least 120% of that calculated to be saturated at a temperature.

"Water" means any aqueous medium with resistance less than one ohm per square centimeter; that is, a medium that can support the electrolysis of water. In general, the lower limit of resistance for a medium that can support electrolysis is water containing more than 2000 ppm total dissolved solids.

The present invention produces microbubbles and nanobubbles of oxygen via the electrolysis of water. As molecular oxygen radical (atomic weight 8) is produced, it reacts to form molecular oxygen, O.sub.2. In the special dimensions of the invention, as explained in more detail in the following examples, O.sub.2 forms bubbles which are too small to break the surface tension of the fluid. These bubbles remain suspended indefinitely in the fluid and, when allowed to build up, make the fluid opalescent or milky. Only after several hours do the bubbles begin to coalesce on the sides of the container and the water clears. During that time, the water is supersaturated with oxygen. In contrast, the H.sub.2 formed readily coalesces into larger bubbles which are discharged into the atmosphere, as can be seen by bubble formation at the cathode.

The first objective of this invention was to make an oxygen emitter with low power demands, low voltage and low current for use with live animals. For that reason, a small button emitter was devised. The anode and cathode were set at varying distances. It was found that electrolysis took place at very short distances before arcing of the current occurred. Surprisingly, at slightly larger distances, the water became milky and no bubbles formed at the anode, while hydrogen continued to be bubbled off the cathode. At distance of 0.140 inches between the anode and cathode, it was observed that the oxygen formed bubbles at the anode. Therefore, the critical distance for microbubble and nanobubble formation was determined to be between 0.005 inches and 0.140 inches.

EXAMPLE 1

Oxygen Emitter

As shown in FIG. 1, the oxygen evolving anode 1 selected as the most efficient is an iridium oxide coated single sided sheet of platinum on a support of titanium (Eltech, Fairport Harbor, Ohio). The cathode 2 is a (fraction (1/16)} inch mesh (size 8 mesh) marine stainless steel screen. The anode and cathode are separated by a non-conducting spacer 3 containing a gap 4 for the passage of gas and mixing of anodic and cathodic water and connected to a power source through a connection point 5. FIG. 2

shows a plan view of the assembled device. The O.sub.2 emitter 6 with the anode connecting wire 7 and the cathode connecting wire 8 is contained in an enclosure 9, connected to the battery compartment 10. The spacer thickness is critical as it sets the critical distance. It must be of sufficient thickness to prevent arcing of the current, but thin enough to separate the electrodes by no more than 0.140 inches. Above that thickness, the power needs are higher and the oxygen bubbles formed at higher voltage will coalesce and escape the fluid. Preferably, the spacer is from 0.005 to 0.075 inches thick. At the lower limits, the emitter tends to foul more quickly. Most preferably, the spacer is about 0.050 inches thick. The spacer may be any nonconductive material such as nylon, fiberglass, Teflon.RTM., polymer or other plastic. Because of the criticality of the space distance, it is preferable to have a non-compressible spacer. It was found that Buna, with a durometer measure of 60 was not acceptable due to decomposition. Viton, a common fluoroelastomer, has a durometer measure of 90 and was found to hold its shape well.

In operation, a small device with an O.sub.2 emitter 1.485 inches in diameter was driven by 4AA batteries. The critical distance was held at 0.050 inches with a Viton spacer. Five gallons of water became saturated in seven minutes. This size is suitable for raising oxygen levels in an aquarium or bait bucket.

It is convenient to attach a control circuit which comprises a timer that is thermostatically controlled by a temperature sensor which determines the off time for the cathode. When the temperature of the solution changes, the resistance of the thermistor changes, which causes an off time of a certain duration. In cool water, the duration is longer so in a given volume, the emitter generates less oxygen. When the water is warmer and therefore hold less oxygen, the duration of off time is shorter. Thus the device is self-controlled to use power most economically. FIG. 3 shows a block diagram of a timer control with anode 1, cathode 2, thermistor temperature sensor 3, timer control circuit 4 and wire from a direct current power source 5.

EXAMPLE 2

Measurement of O.sub.2 Bubbles

Attempts were made to measure the diameter of the O.sub.2 bubbles emitted by the device of Example 1. In the case of particles other than gasses, measurements can easily be made by scanning electron microscopy, but gasses do not survive electron microscopy. Large bubble may be measured by pore exclusion, for example, which is also not feasible when measuring a gas bubble. A black and white digital, high contrast, backlit photograph of treated water with a millimeter scale reference was shot of water produced by the emitter of Example 1. About 125 bubbles were seen in the area selected for measurement. Seven bubbles ranging from the smallest clearly seen to the largest were measured. The area was enlarged, giving a scale multiplier of 0.029412.

Recorded bubble diameters at scale were 0.16, 0.22, 0.35, 0.51, 0.76, 0.88 and 1.09 millimeters. The last three were considered outliers by reverse analysis of variance and were assumed to be hydrogen bubbles. When multiplied by the scale multiplier, the assumed O.sub.2 bubbles were found to range from 4.7 to 15 microns in diameter. This test was limited by the resolution of the camera and smaller bubbles in the nanometer range could not be resolved. It is known that white light cannot resolve features in the nanometer size range, so monochromatic laser light may give resolution sensitive enough to measure smaller bubbles. Efforts continue to increase the sensitivity of measurement so that sub-micron diameter bubbles can be measured.

EXAMPLE 3

Other Models of Oxygen Emitter

Depending on the volume of fluid to be oxygenated, the oxygen emitter of this invention may be shaped as a circle, rectangle, cone or other model. One or more may be set in a substrate that may be metal, glass, plastic or other material. The substrate is not critical as long as the current is isolated to the electrodes by the nonconductor spacer material of a thickness from 0.005 to 0.075 inches, preferably 0.050 inches. It has been noticed that the flow of water seems to be at the periphery of the emitter, while the evolved visible bubbles (H.sub.2) arise at the center of the emitter. Therefore, a funnel or pyramidal shaped emitter was constructed to treat larger volumes of fluid. FIG. 4 is a cross sectional diagram of such an emitter. The anode 1 is formed as an open grid separated from a marine grade stainless steel screen cathode 2 by the critical distance by spacer 3 around the periphery of the emitter and at the apex. This flow-through embodiment is suitable for treating large volumes of water rapidly.

The size may be varied as required. A round emitter for oxygenating a bait bucket may be about 2 inches in diameter, while a 3-inch diameter emitter is adequate for oxygenating a 10 to 40 gallon tank. The live well of a fishing boat will generally hold 40 to 80 gallons of water and require a 4-inch diameter emitter. It is within the scope of this invention to construct larger emitters or to use several in a series to oxygenate larger volumes. It is also within the scope of this invention to vary the model to provide for low voltage and amperage in cases where the need for oxygen is moderate and long lasting or conversely, to supersaturate water very quickly at higher voltage and amperage. In the special dimensions of the present invention, it has been found that a 6 volt battery supplying a current as low as 40 milliamperes is sufficient to generate oxygen. Such a model is especially useful with live plants or animals, while it is more convenient for industrial use to use a higher voltage and current. Table I shows a number of models suitable to various uses.

TABLE-US-00002 TABLE I Emitter Model Gallons Volts Amps Max. Ave Watts Bait keeper 5 6 0.090 0.060 0.36 Livewell 32 12 0.180 0.120 1.44 OEM 2 inch 10 12 0.210 0.120 1.44 Bait store 70 12 0.180 0.180 2.16 Double cycle 2 12 0.180 0.180 2.16 OEM 3 inch 50 12 0.500 0.265 3.48 OEM 4 inch 80 12 0.980 0.410 4.92 Water pail 2 24 1.200 1.200 28.80 Plate 250 12 5.000 2.500 30.00

EXAMPLE 4

Multilayer Sandwich O.sub.2 Emitter

An O.sub.2 emitter was made in a multilayer sandwich embodiment. (FIG. 5) An iridium oxide coated platinum anode 1 was formed into a grid to allow good water flow and sandwiched between two stainless steel screen cathodes 2. Spacing was held at the critical distance by nylon spacers 3. The embodiment illustrated is held in a cassette 4 which is secured by nylon bolt 5 with a nylon washer 6. The dimensions selected were:

TABLE-US-00003 cathode screen 0.045 inches thick nylon spacer 0.053 inches thick anode grid 0.035 inches thick nylon spacer 0.053 inches thick cathode screen 0.045 inches thick,

for an overall emitter thickness of 0.231 inches thick inches.

If a more powerful emitter is desired, it is within the scope of this invention to repeat the sequence of stacking. For example, an embodiment may easily be constructed with this sequence: cathode, spacer, anode, spacer, cathode, spacer, anode, spacer, cathode, spacer, anode, spacer, cathode. The number of layers in the sandwich is limited only by the power requirements acceptable for an application.

EXAMPLE 5

Effect of Superoxygenated Water on the Growth of Plants

It is known that oxygen is important for the growth of plants. Although plants evolve oxygen during photosynthesis, they also have a requirement for oxygen for respiration. Oxygen is evolved in the leaves of the plants, while often the roots are in a hypoxic environment without enough oxygen to support optimum respiration, which can be reflected in less than optimum growth and nutrient utilization. Hydroponically grown plants are particularly susceptible to oxygen deficit in the root system. U.S. Pat. No. 5,887,383 describes a liquid supply pump unit for hydroponic cultures which attain oxygen enrichment by sparging with air. Such a method has high energy requirements and is noisy. Furthermore, while suitable for self-contained hydroponic culture, the apparatus is not usable for field irrigation. In a report available on the web, it was shown that hydroponically grown cucumbers and tomatoes supplied with water oxygenated with a device similar to that described in the '429 patent had increased biomass of about 12% and 17% respectively. It should be noted that when sparged with air, the water may become saturated with oxygen, but it is unlikely that the water is superoxygenated.

A. Superoxygenated Water in Hydroponic Culture.

Two small hydroponic systems were set up to grow two tomato plants. Circulation protocols were identical except that the 2 1/2 gallon water reservoir for the Control plant was eroated with and aquarium bubbler and that for the Test plant was oxygenated with a five-inch strip emitter for two minutes prior to pumping. The cycle was set at four minutes of pumping, followed by four minutes of rest. The control water had an oxygen content of about 97% to 103% saturation, that is, it was saturated with oxygen. The test water had an oxygen content of about 153% to 165% saturation, that is, it was supersaturated. The test plant was at least four times the volume of the control plant and began to show what looked like fertilizer burn. At that point the fertilizer for the Test plant was reduced by half. Since the plants were not exposed to natural light but to continuous artificial light in an indoor environment without the natural means of fertilization (wind and/or insects), the experiment was discontinued after three months. At that time, the Test plant but not the Control plant had blossomed.

B. Superoxygenated Water in Field Culture.

A pilot study was designed to ascertain that plants outside the hydroponic culture facility would benefit from the application of oxygen. It was decided to use water treated with the emitter of Example 1 as the oxygen carrier. Since water so treated is supersaturated, it is an excellent carrier of oxygen.

Tomato seeds (Burpee "Big Boy") were planted in one-inch diameter peat and dirt plugs encased in cheese cloth and placed in a tray in a southwest window. Controls were watered once a day with tap water ("Control") or oxygenated water ("Test"). Both Controls and Test sprouted at one week. After five weeks, the Test plants were an average of 11 inches tall while the Controls were an average of nine inches tall. At this time, May 10, when the threat of frost in Minnesota was minimal, the plants were transplanted to 13 inch diameter pots with drainage holes. Four inches of top soil was added to each pot, topped off with four inches of Scott's Potting Soil. The pots were placed outside in a sunny area with at least eight hours a day of full sun. The plants were watered as needed with either plain tap water (Control) or oxygenated water (Test). The oxygenated water was produced by use of the emitter of Example 1 run for one-half hour in a five-gallon container of water. Previous experiments showed that water thus treated had an oxygen content from 160% to 260% saturation. The Test plants flowered on June 4, while the Controls did not flower until June 18. For both groups, every plant in the group first had flowers on the same day. All plants were fertilized on July 2 and a soaker hose provided because the plants were now so big that watering by hand was difficult. The soaker hose was run for one half to one hour each morning, depending on the weather, to a point at which the soil was saturated with water. One

half hour after the soaker hose was turned off, about 750 ml of superoxygenated water was applied to each of the Test plants.

The Test plants were bushier than the Controls although the heights were similar. At this time, there were eight Control plants and seven Test plants because one of the Test plants broke in a storm. On July 2, the control plants averaged about 17 primary branches from the vine stem, while the control plants averaged about 13 primary branches from the vine stem. As the tomatoes matured, each was weighed on a kitchen scale at harvest. The yield history is shown in Table II.

TABLE-US-00004 TABLE II Control, grams Test, grams tomatoes from tomatoes from eight plants/ seven plants/ Week of: cumulative total cumulative total July 27 240 400 August 3 180 420 2910 3310 August 10 905 1325 1830 5140 August 17 410 1735 2590 7730 August 24 3300 5035 2470 10200 August 31 4150 9175 1580 11780 September 15 not weighed 3710 15490 Final Harvest 6435 15620 8895 24385 September 24

The total yield for the eight Control plants was 15620 grams or 1952 grams of tomatoes per plant.

The total yield for the seven Test plants was 24385 grams or 3484 grams of tomatoes per plant, an increase in yield of about 79% over the Control plants.

FIG. 6 shows the cumulative total as plotted against time. Not only did the Test plants blossom and bear fruit earlier, but that the Control plants never caught up to the test plants in the short Minnesota growing season. It should be noted that the experiment was terminated because of predicted frost. All fruits, both green and red, were harvested and weighed at that point.

EXAMPLE 6

Flow-Through Emitter for Agricultural Use

In order to apply the findings of example 5 to agricultural uses, an emitter than can oxygenate running water efficiently was developed. In FIG. 7(A), the oxygenation chamber is comprised of three anodes 1 and cathodes 2, of appropriate size to fit inside a tube or hose and separated by the critical distance are placed within a tube or hose 3 at 120.degree. angles to each other. The anodes and cathodes are positioned with stabilizing hardware 4. The stabilizing hardware, which can be any configuration such as a screw, rod or washer, is preferably formed from stainless steel. FIG. 7(B) shows a plan view of the oxygenation chamber with stabilizing hardware 4 serving as a connector to the power source and stabilizing hardware 5 serving as a connector to the power source. The active area is shown at 6.

This invention is not limited to the design selected for this embodiment. Those skilled in the art can readily fabricate any of the emitters shown in FIG. 4 or 5, or can design other embodiments that will oxygenate flowing water. One useful embodiment is the "T" model, wherein the emitter unit is set in a side arm. The emitted bubbles are swept into the water flow. The unit is detachable for easy servicing. Table III shows several models of flow through emitters. The voltage and flowrates were held constant and the current varied. The Dissolved oxygen (DO) from the source was 7.1 mg/liter. The starting temperature was 12.2.degree. C. but the flowing water cooled slightly to 11 or 11.5.degree. C. Without undue experimentation, anyone may easily select the embodiment that best suits desired characteristics from Table III or designed with the teachings of Table III.

TABLE-US-00005 TABLE III ACTIVE DO OF* ELECTRODE CURRENT, FLOW RATE SAMPLE AT MODEL AREA, SQ.IN. VOLTAGE AMPS. GAL/MINUTE ONE MINUTE 2-Inch "T" 2 28.3 0.72 12 N/A 3-inch "T" 3 28.3 1.75 12 N/A 2-plate Tube 20 28.3 9.1 12 8.4 3-Plate tube 30 28.3 12.8 12 9.6

*As the apparatus runs longer, the flowing water becomes milky, indicating supersaturation. The one-minute time point shows the rapid increase in oxygenation.

The following plants will be tested for response to superoxygenated water: grape vines, lettuce, and radishes in three different climate zones. The operators for these facilities will be supplied with units for drip irrigation. Drip irrigation is a technique wherein water is pumped through a pipe or hose with perforations at the site of each plant to be irrigated. The conduit may be underground or above ground. Since the water is applied directly to the plant rather than wetting the entire field, this technique is especially useful in arid climates or for plants requiring high fertilizer applications.

The superoxygenated water will be applied by drip irrigation per the usual protocol for the respective plants. Growth and yield will be compared to the same plants given only the usual irrigation water. Pest control and fertilization will be the same between test and control plants, except that the operators of the experiments will be cautioned to be aware of the possibility of fertilizer burn in the test plants and to adjust their protocols accordingly.

It is expected that the superoxygenated plants with drip irrigation will show more improved performance with more continuous application of oxygen than did the tomato plants of Example 5, which were given superoxygenated water only once a day.

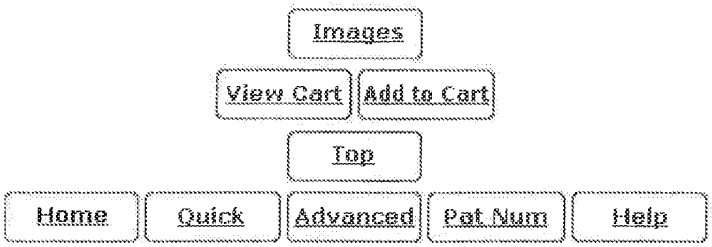
EXAMPLE 7

Treatment of Waste Water

Waste water, with a high organic content, has a high BOD, due to the bacterial flora. It is desirable to raise the oxygen content of the waste water in order to cause the flora to flocculate. However, it is very difficult to effectively oxygenate such water. Using a 4 inch OEM (see Table I) with a 12 volt battery, four liters of waste water in a five gallon pail were oxygenated. As shown in FIG. 8, the dissolved oxygen went from 0.5 mg/l to 10.8 mg/l in nine minutes.

Those skilled in the art will readily comprehend that variations, modifications and additions may in the embodiments described herein may be made. Therefore, such variations, modifications and additions are within the scope of the appended claims.

* * * * *



UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,670,495 B2
APPLICATION NO. : 12/023431
DATED : March 2, 2010
INVENTOR(S) : Senkiw

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 10, Line 55:
Delete "breading" and insert --breaking--.

Signed and Sealed this

First Day of June, 2010

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

SPE RESPONSE FOR CERTIFICATE OF CORRECTION

Paper No.: _____

DATE : 04/20/10

TO SPE OF : ART UNIT 1797

SUBJECT : Request for Certificate of Correction for Appl. No.: 12023431 Patent No.: 7670495

Please respond to this request for a certificate of correction within 7 days.

FOR IFW FILES:

Please review the requested changes/corrections as shown in the **COCIN** document(s) in the IFW application image. No new matter should be introduced, nor should the scope or meaning of the claims be changed.

Please complete the response (see below) and forward the completed response to scanning using document code **COCX**.

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Thank You For Your Assistance

The request for issuing the above-identified correction(s) is hereby:
Note your decision on the appropriate box.

☑ **Approved**	**All** changes apply.
☐ **Approved in Part**	Specify below which changes **do not** apply.
☐ **Denied**	State the reasons for denial below.

Comments: _____

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/Walter D. Griffin/
SPE

1797
Art Unit

PTOL-306 (REV. 7/03) U.S. DEPARTMENT OF COMMERCE Patent and Trademark Office

JA738

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the patent of:	Attorney Docket No.: 4056.02US03
Senkiw	Confirmation No.: 7381
Patent No.: 7,670,495	Application No.: 12/023,431
Issued: March 2, 2010	Filed: January 31, 2008
For: FLOW-THROUGH OXYGENATOR	

REQUEST FOR CERTIFICATE OF CORRECTION

Attention Certificate of Correction Branch
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

It is respectfully requested that a Certificate of Correction be issued to correct the error specified in the attached duplicate copies of Certificate of Correction Form PTO-1050.

Electronic payment is submitted by credit card in accordance with the provisions of 37 CFR § 1.323. Please charge any additional fees due or credit any overpayment to Deposit Account No. 16-0631 as needed to ensure prompt issuance of a Certificate of Correction.

Respectfully submitted,

J. Paul Haun
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Customer No. 24113
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Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 16-0631.

PTO/SB/44 (09-2007)
Approved for use through 08/31/2010. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.:	7,670,495	Page 1 of 1
APPLICATION NO.:	12/023,431	
ISSUE DATE:	3/2/2010	
INVENTOR(S):	Senkiw	

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 10, Line 55:
Delete "breading" and insert –breaking--.

MAILING ADDRESS OF SENDER (Please do not use customer number below):

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PTO/SB/44 (09-2007)
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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO.: 7,670,495 Page 1 of 1

APPLICATION NO.: 12/023,431

ISSUE DATE: 3/2/2010

INVENTOR(S): Senkiw

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Electronic Patent Application Fee Transmittal	
Application Number:	12023431
Filing Date:	31-Jan-2008
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Filer:	J. Paul Haun/Valerie Mitchell
Attorney Docket Number:	4056.02US03
Filed as Large Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Certificate of correction	1811	1	100	100
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**100**

Electronic Acknowledgement Receipt	
EFS ID:	7413685
Application Number:	12023431
International Application Number:	
Confirmation Number:	7381
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	24113
Filer:	J. Paul Haun/Valerie Mitchell
Filer Authorized By:	J. Paul Haun
Attorney Docket Number:	4056.02US03
Receipt Date:	14-APR-2010
Filing Date:	31-JAN-2008
Time Stamp:	15:23:18
Application Type:	Utility under 35 USC 111(a)

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Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$100
RAM confirmation Number	11419
Deposit Account	160631
Authorized User	HAUN,JAMES PAUL
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees) Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Certificate of Correction	4056_02US03_CERT_CORR.pdf	89757 74e66725d368e5f5f6df0b2dc170b4cd1121e04b	no	3
Warnings:					
Information:					
2	Fee Worksheet (PTO-875)	fee-info.pdf	30265 2ea5781e01d869a0cd8652c9e19b483e7487d5b4	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	120022		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/023,431	03/02/2010	7670495	4056.02US03	7381

24113 7590 02/10/2010

PATTERSON, THUENTE, SKAAR & CHRISTENSEN, P.A.
4800 IDS CENTER
80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402-2100

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

James Andrew Senkiw, Minneapolis, MN;

IR103 (Rev. 10/09)

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/023,431	01/31/2008	James Andrew Senkiw	4056.02US03	7381

24113 7590 01/25/2010

PATTERSON, THUENTE, SKAAR & CHRISTENSEN, P.A.
4800 IDS CENTER
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MINNEAPOLIS, MN 55402-2100

EXAMINER	
ALLEN, CAMERON J	
ART UNIT	PAPER NUMBER
1797	

MAIL DATE	DELIVERY MODE
01/25/2010	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

UNITED STATES DEPARTMENT OF COMMERCE
U.S. Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
12023431	1/31/2008	SENKIW, JAMES ANDREW	4056.02US03

PATTERSON, THUENTE, SKAAR & CHRISTENSEN, P.A.
4800 IDS CENTER
80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402-2100

EXAMINER	
CAMERON J. ALLEN	
ART UNIT	**PAPER**
1797	20100121

DATE MAILED:

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Commissioner for Patents

IDS after Notice of Allowance has been considered. See attachment. IDS is ok to enter.

/Walter D. Griffin/
Supervisory Patent Examiner, Art Unit 1797

PTO-90C (Rev.04-03)

OK TO ENTER: /C.A./

Substitute for form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*				*Complete if Known*	
				Application Number	12/023,431
				Filing Date	January 31, 2008
				First Named Inventor	Senkiw
				Art Unit	1797
				Examiner Name	Cameron J. Allen
Sheet	1	of	1	Attorney Docket Number	4056.02US03

U.S. PATENT DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document
/C.A./		US-2008/0202995 A1*	08-28-2008	Senkiw
/C.A./		US-7,396,441 B2*	07-08-2008	Senkiw
/C.A./		US-2006/0150491 A1*	07-13-2006	Senkiw
/C.A./		US-6,689,262 B2*	02-10-2004	Senkiw
/C.A./		US-6,524,475 B1	02-25-2003	Herrington et al.
		US-		
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		US-		
		US-		

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	T[6]

EXAMINER SIGNATURE	/Cameron Allen/	DATE CONSIDERED	01/21/2010

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450.**

~~ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.A./~~

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

24113 7590 09/23/2009

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4800 IDS CENTER
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MINNEAPOLIS, MN 55402-2100

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Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/023,431	01/31/2008	James Andrew Senkiw	4056.02US03	7381

TITLE OF INVENTION: FLOW-THROUGH OXYGENATOR

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$755	$300	$0	$1055	12/23/2009

EXAMINER	ART UNIT	CLASS-SUBCLASS
ALLEN, CAMERON J	1797	210-748000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Patterson, Thuente, Skaar & Christensen, P.A
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: OXYGENATOR WATER TECHNOLOGIES, INC. D/B/A WATER D.O.G. WORKS

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Minnetonka, Minnesota

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☑ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☑ Issue Fee
☑ Publication Fee (No small entity discount permitted)
☑ Advance Order - # of Copies 10

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 16-0631 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date 10/22/09

Typed or printed name J. Paul Haun Registration No. 53,003

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PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Electronic Patent Application Fee Transmittal	
Application Number:	12023431
Filing Date:	31-Jan-2008
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Filer:	J. Paul Haun/Valerie Mitchell
Attorney Docket Number:	4056.02US03
Filed as Small Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl issue fee	2501	1	755	755
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
Printed copy of patent - no color	8001	10	3	30
		Total in USD ($)		**1085**

Electronic Acknowledgement Receipt	
EFS ID:	6312370
Application Number:	12023431
International Application Number:	
Confirmation Number:	7381
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	24113
Filer:	J. Paul Haun/Valerie Mitchell
Filer Authorized By:	J. Paul Haun
Attorney Docket Number:	4056.02US03
Receipt Date:	22-OCT-2009
Filing Date:	31-JAN-2008
Time Stamp:	15:35:41
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$1085
RAM confirmation Number	1708
Deposit Account	160631
Authorized User	HAUN,JAMES PAUL
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Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	4056_02US03_ISSUE_FEE.pdf	93863 2548760f56d87322d8dc53a6968b5a06571bfd4d	no	1
Warnings:					
Information:					
2	Fee Worksheet (PTO-875)	fee-info.pdf	33583 9697d00c5e222627bc2229a141956b56efe652ab	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	127446		

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National Stage of an International Application under 35 U.S.C. 371
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New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Substitute for form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*				*Complete if Known*	
				Application Number	12/023,431
				Filing Date	January 31, 2008
				First Named Inventor	Senkiw
				Art Unit	1797
				Examiner Name	Cameron J. Allen
Sheet	1	of	1	Attorney Docket Number	4056.02US03

U.S. PATENT DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document
		US-2008/0202995 A1*	08-28-2008	Senkiw
		US-7,396,441 B2*	07-08-2008	Senkiw
		US-2006/0150491 A1*	07-13-2006	Senkiw
		US-6,689,262 B2*	02-10-2004	Senkiw
		US-6,524,475 B1	02-25-2003	Herrington et al.
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FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	T[6]

EXAMINER SIGNATURE		DATE CONSIDERED	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450.**

Electronic Patent Application Fee Transmittal	
Application Number:	12023431
Filing Date:	31-Jan-2008
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Filer:	J. Paul Haun/Valerie Mitchell
Attorney Docket Number:	4056.02US03
Filed as Small Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	180	180
		Total in USD ($)		**180**

Electronic Acknowledgement Receipt	
EFS ID:	6185591
Application Number:	12023431
International Application Number:	
Confirmation Number:	7381
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	24113
Filer:	J. Paul Haun/Valerie Mitchell
Filer Authorized By:	J. Paul Haun
Attorney Docket Number:	4056.02US03
Receipt Date:	01-OCT-2009
Filing Date:	31-JAN-2008
Time Stamp:	14:41:23
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$180
RAM confirmation Number	895
Deposit Account	160631
Authorized User	HAUN,JAMES PAUL
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		4056_02US03_SUPP_IDS.pdf	156910 20d03b9c5edc4ec17ce3f0ea83824dff447e769c	yes	4
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Transmittal Letter		1	3	
	Information Disclosure Statement (IDS) Filed (SB/08)		4	4	
Warnings:					
Information:					
2	NPL Documents	4056_04US02_11367134.pdf	12835421 945639049 72aa53e57d8d4442d7e69d0bfbcbf5e	no	311
Warnings:					
Information:					
3	NPL Documents	4056_04US01_10372017.pdf	1340280 2aa5d13b88630ed0bced0b6c867e125246ff7439	no	33
Warnings:					
Information:					
4	NPL Documents	4056_02US02_12023416.pdf	9288616 e098bbc5407da40811a594c18f9c319af5e99a27	no	208
Warnings:					
Information:					
5	NPL Documents	4056_02US01_10732326.pdf	10985936 df7c21d5e1d77f37d2533a8da02c74b6e3d32e22	no	278
Warnings:					
Information:					
6	Fee Worksheet (PTO-875)	fee-info.pdf	30403 041e6fe6e54f4ced66ae23c1ea7ec21ff93a6b26	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	34637566		

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New Applications Under 35 U.S.C. 111
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National Stage of an International Application under 35 U.S.C. 371
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New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:	Attorney Docket No.: 4056.02US03
Senkiw	Confirmation No.: 7381
Application No.: 12/023,431	Examiner: Cameron J. Allen
Filed: January 31, 2008	Group Art Unit: 1797

For: FLOW-THROUGH OXYGENATOR

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Pursuant to 37 CFR § 1.56, and in addition to information disclosed in any prior Information Disclosure Statements filed, the attention of the Patent and Trademark Office is hereby directed to the references listed on the attached Form PTO-1449. It is respectfully requested that the information be expressly considered during the prosecution of the above-referenced application, and be made of record therein and appear among the "References Cited" on any patent to issue therefrom.

The listing of a reference herein is not an admission that the reference is prior art or is material to patentability. 37 CFR § 1.97(h). Applicant reserves the right to establish the patentability of any claimed invention over any of the information provided herewith, and/or prove that this information may not be prior art, and/or prove that this information may not be enabling for any aspect of the information provided herewith.

This Information Disclosure Statement is being filed more than three months after the U.S. filing date and after the mailing date of a Final Action or Notice of Allowance, or an action that otherwise closes prosecution in the application but before payment of the Issue Fee, but with a fee as provided for under 37 CFR § 1.97(c)(1). It is hereby requested that the Information Disclosure Statement be considered in accordance with the payment in the amount of $180.00 for the petition fee under 37 CFR § 1.17(p) that is submitted herewith. Electronic payment is submitted by credit card to cover the fee. Please credit or debit Deposit Account No. 16-0631 as needed to ensure consideration of the disclosed information.

The Examiner's attention is directed to the applications, if any, to which priority is claimed, as well as to any continuing applications which claim priority to the above-referenced application, and to applications, if any, that may be related to a similar technology as the above-referenced application and which are also assigned to the assignee of the above-referenced application (collectively, the "Related applications"). The Related applications are identified on the attached form PTO-1449 by serial number, publication number and/or patent number and with an asterisk (*).

The prosecution history for any and all of these Related applications may include information material to patentability of the above-referenced application including Office Actions, Responses, Office Communications or Notices of Allowance, all of which are readily accessible to the Examiner via PAIR/PALM. To promote consistency and full disclosure during the prosecution of the above-referenced application together with the prosecution of any Related applications and to assist the Examiner in complying with the obligations of MPEP 2001.06(b), the Examiner is respectfully requested to review the prosecution history of each Related

application. This request for review should be considered ongoing throughout the prosecution of the above-referenced application with an updated review via PAIR/PALM of the prosecution histories of any Related application being made prior to issuance of any Notice of Allowance for the above-referenced application.

The identification of any of the Related applications for purposes of this Information Disclosure Statement should not to be construed as a waiver of secrecy, if applicable, as to such applications now or upon issuance of the above-referenced application as a patent. For purposes of the Related applications, it should be noted that all of the Related applications are published or otherwise publicly available on PAIR.

Respectfully submitted,

J. Paul Haun
Registration No. 53,003

Customer No. 24113
Patterson, Thuente, Skaar & Christensen, P.A.
4800 IDS Center
80 South 8th Street
Minneapolis, Minnesota 55402-2100
Telephone: (612) 349-3009

Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 16-0631.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

24113 7590 09/23/2009

PATTERSON, THUENTE, SKAAR & CHRISTENSEN, P.A.
4800 IDS CENTER
80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402-2100

EXAMINER	
ALLEN, CAMERON J	
ART UNIT	PAPER NUMBER
1797	

DATE MAILED: 09/23/2009

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/023,431	01/31/2008	James Andrew Senkiw	4056.02US03	7381

TITLE OF INVENTION: FLOW-THROUGH OXYGENATOR

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$755	$300	$0	$1055	12/23/2009

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

24113 7590 09/23/2009

PATTERSON, THUENTE, SKAAR & CHRISTENSEN, P.A.
4800 IDS CENTER
80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402-2100

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/023,431	01/31/2008	James Andrew Senkiw	4056.02US03	7381

TITLE OF INVENTION: FLOW-THROUGH OXYGENATOR

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$755	$300	$0	$1055	12/23/2009

EXAMINER	ART UNIT	CLASS-SUBCLASS
ALLEN, CAMERON J	1797	210-748000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/023,431	01/31/2008	James Andrew Senkiw	4056.02US03	7381

24113 7590 09/23/2009

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80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402-2100

EXAMINER	
ALLEN, CAMERON J	
ART UNIT	PAPER NUMBER
1797	

DATE MAILED: 09/23/2009

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 0 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 0 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

Notice of Allowability	Application No.	Applicant(s)	
	12/023,431	SENKIW, JAMES ANDREW	
	Examiner	Art Unit	
	CAMERON J. ALLEN	1797	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *the response filed on 8/20/2009*.

2. ☒ The allowed claim(s) is/are *1-12*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

DETAILED ACTION

Allowable Subject Matter

Claims 1-12 are allowed.

The following is an examiner's statement of reasons for allowance: The prior art does not disclose a method for treating waste water comprising providing a flow-through oxygenator comprising an emitter for electrolytic generation of microbubbles of oxygen comprising an anode separated at a critical distance from a cathode or placing the emitter within a conduit. The prior art also does not disclose nor fairly suggest an anode separated at a critical distance from a cathode, wherein the critical distance results in the formation of oxygen bubbles having a bubble diameter less than 0.0006 inches, said oxygen bubbles being incapable of breading the surface tension of the aqueous medium such that said aqueous medium is supersaturated with oxygen.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CAMERON J. ALLEN whose telephone number is (571)270-3164. The examiner can normally be reached on M-Th 9-7pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Walter Griffin can be reached on 571-272-1447. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

CJA

/Walter D. Griffin/
Supervisory Patent Examiner, Art Unit 1797

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12023431	SENKIW, JAMES ANDREW
	Examiner	**Art Unit**
	CAMERON J ALLEN	1797

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☒ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/21/2009								
	1	=								
	2	=								
	3	=								
	4	=								
	5	=								
	6	=								
	7	=								
	8	=								
	9	=								
	10	=								
	11	=								
	12	=								

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12023431	SENKIW, JAMES ANDREW
	Examiner	**Art Unit**
	CAMERON J ALLEN	1797

ORIGINAL		INTERNATIONAL CLASSIFICATION	
CLASS	SUBCLASS	CLAIMED	NON-CLAIMED
210	748	C 0 2 F 1 / 48 (2006.01.01)	
CROSS REFERENCE(S)		C 2 5 B 1 / 02 (2006.01.01)	
		C 2 5 B 1 / 04 (2006.01.01)	
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)	C 0 2 F 1 / 00 (2006.01.01)	
210	600 243		
204	245 232		
205	628		

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☒ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

/CAMERON J ALLEN/ Examiner.Art Unit 1797 (Assistant Examiner)	9/21/2009 (Date)	**Total Claims Allowed:** 12
/WALTER D GRIFFIN/ Supervisory Patent Examiner.Art Unit 1797 (Primary Examiner)	09/22/2009 (Date)	O.G. Print Claim(s): 1 O.G. Print Figure: 1

U.S. Patent and Trademark Office — Part of Paper No. 20090921

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12023431	SENKIW, JAMES ANDREW
	Examiner	Art Unit
	CAMERON J ALLEN	1797

SEARCHED			
Class	Subclass	Date	Examiner
210	748, 600, 243	2/25/2009	CA
204	278, 242, 243, 275.1, 232, 286.1, 554, 660,	2/25/2009	CA
205	633-638	2/25/2009	CA

SEARCH NOTES		
Search Notes	Date	Examiner
See East Search History	2/25/2009	CA
Inventor Search	2/25/2009	CA

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
	See East Search History	9/21/2009	CA

U.S. Patent and Trademark Office

Part of Paper No. : 20090921

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	19	"6689262"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/24 14:01
S2	12	("3975269" | "4012319" | "4732661" | "4908109" | "5049252" | "5182014" | "5534143" | "6315886" | "6394429" | "6471873" | "WO 9521795").PN. OR ("6689262").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2009/02/24 14:04
S3	12	("20020074237" | "4225401" | "4252856" | "4587001" | "5015354" | "5534143" | "5982609" | "6171469" | "6315886" | "6328875" | "6394429" | "6689262").PN. OR ("7396441").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2009/02/24 14:19
S4	0	systems and methods for process stream treatment	US-PGPUB; USPAT; USOCR	ADJ	ON	2009/02/25 10:34
S5	0	pct/us2007/026219	US-PGPUB; USPAT; USOCR	ADJ	ON	2009/02/25 10:34
S6	0	pct/us07/026219	US-PGPUB; USPAT; USOCR	ADJ	ON	2009/02/25 10:34
S7	0	pctus07026219	US-PGPUB; USPAT; USOCR	ADJ	ON	2009/02/25 10:34
S8	0	60/871496	US-PGPUB; USPAT; USOCR	ADJ	ON	2009/02/25 10:35
S9	9	"4225401"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:42

S13	58	"5982609"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:42
S15	2	"63158866"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:42
S16	17	"6328875"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:43
S18	7	2002/0074237	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:43
S19	0	2003/0164306	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:43
S21	2	"20020074237"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:43
S22	19	"6689262"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:43
S23	1	wo 99/39561	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:44
S24	1	wo 03/072507	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:44
S25	7	"5148772"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:46

S26	11	"4257352"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:46
S28	0	wo 01/89997	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:46
S29	0	ep "0723936"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:46
S30	1	gb "1522188"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:47
S31	1	"12023431"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:53
S32	944	204/278.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:04
S33	0	204/275.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:04
S34	1582	204/242.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:04
S35	703	204/245.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:04
S36	842	204/275.1.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:05

S37	297	204/232.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:05
S38	229	204/554.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:05
S39	273	204/660.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:05
S40	0	204/243.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:05
S41	179	204/286.1.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:05
S42	660	210/243.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:07
S43	127	205/633.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:11
S44	8	"4071447"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:34
S45	2	"20030164306"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:35
S46	8	"5015354"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 22:10

S47	27	"4252856"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 09:49
S48	20	"5534143"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 09:52
S49	7	"6171469"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 09:54
S50	13	"6394429"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 09:54
S51	10	SENKIW, JAMES.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 09:58
S52	585	(205/633-638).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:04
S53	4	S52 and microbubbles	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:04
S54	0	S52 and micro adj bubbles	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:04
S55	89268	electrolysis	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:05
S56	5797	oxygenator	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:05

S57	6	S52 and S56	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:05
S58	700	oxygenator.clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:09
S59	231	oxygenator.clm.	US-PGPUB	ADJ	ON	2009/02/26 10:09
S60	4	flow through oxygenator.clm.	US-PGPUB	ADJ	ON	2009/02/26 10:09
S61	3	2002/0074237	US-PGPUB	ADJ	ON	2009/02/26 10:14
S62	1	"20020074237"	US-PGPUB	ADJ	ON	2009/02/26 10:15
S63	0	jp "2000384641"	US-PGPUB	ADJ	ON	2009/02/26 10:17
S64	0	jp "2000/384641"	US-PGPUB	ADJ	ON	2009/02/26 10:17
S65	0	jp "2000-384641"	US-PGPUB	ADJ	ON	2009/02/26 10:17
S66	0	kiyoyuki Takesako.in.	US-PGPUB	ADJ	ON	2009/02/26 10:17
S67	300	(205/628).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:36

9/21/2009 10:25:17 PM
C:\Documents and Settings\callen\My Documents\EAST\Workspaces\12023431.wsp

Application Number	Application/Control No.	Applicant(s)/Patent under Reexamination	
	12/023,431	SENKIW, JAMES ANDREW	
Document Code - DISQ	**Internal Document – DO NOT MAIL**		

TERMINAL DISCLAIMER	☒ APPROVED	☐ DISAPPROVED
Date Filed : 08/20/09	**This patent is subject to a Terminal Disclaimer**	**REASONS:**

Approved/Disapproved by:

Jan Hurley
Paralegal Specialist
Patent Legal Research Center

09/17/09

U.S. Patent and Trademark Office

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:	Attorney Docket No.: 4056.02US03
Senkiw	Confirmation No.: 7381
Application No.: 12/023,431	Examiner: Cameron J. Allen
Filed: January 31, 2008	Group Art Unit: 1797
For: FLOW-THROUGH OXYGENATOR	

TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A PRIOR PATENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The owner, Oxygenator Water Technologies, Inc. d/b/a Water D.O.G. Works, of the entire interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application, which would extend beyond the expiration date of the full statutory term defined in 35 U.S.C. §§ 154 to 156 and 173, as presently shortened by any terminal disclaimer, of prior U.S. Patent Nos. 6,689,262 and 7,396,441. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. §§ 154 to 156 and 173 of the prior patent, as presently shortened by any terminal disclaimer, in the event that the prior patent later: expires for failure

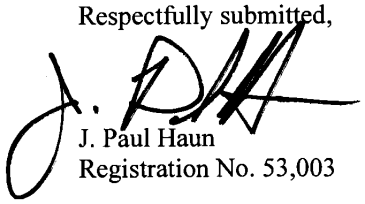
to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR § 1.321, has all claims canceled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer filed.

The above disclaimer is not intended, and shall not be construed under any circumstances, as an admission that any invention claimed in a patent granted on the instant application is obvious in view of the prior patent or that the prior patent constitutes prior art to the instant application. See Quad Environmental Technologies Corp. v. Union Sanitary District, 946 F.2d. 870, 874 (Fed. Cir. 1991).

Electronic payment is submitted by credit card in payment of the fee required under 37 CFR § 1.321(b) and § 1.20(d). The Commissioner is hereby authorized to grant any extension of time necessary for consideration of this paper, and/or to charge any fee or credit any overpayment to Deposit Account No. 16-0631.

The undersigned is an attorney or agent of record.

Respectfully submitted,



J. Paul Haun
Registration No. 53,003

Customer No. 24113
Patterson, Thuente, Skaar & Christensen, P.A.
4800 IDS Center
80 South 8th Street
Minneapolis, Minnesota 55402-2100
Telephone: (612) 349-3009

Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 16-0631.

Electronic Patent Application Fee Transmittal	
Application Number:	12023431
Filing Date:	31-Jan-2008
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Filer:	J. Paul Haun/Valerie Mitchell
Attorney Docket Number:	4056.02US03
Filed as Small Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 2 months with $0 paid	2252	1	245	245

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Statutory disclaimer	2814	1	70	70
		Total in USD ($)		**315**

Electronic Acknowledgement Receipt	
EFS ID:	5926800
Application Number:	12023431
International Application Number:	
Confirmation Number:	7381
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	24113
Filer:	J. Paul Haun/Valerie Mitchell
Filer Authorized By:	J. Paul Haun
Attorney Docket Number:	4056.02US03
Receipt Date:	20-AUG-2009
Filing Date:	31-JAN-2008
Time Stamp:	16:53:41
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$315
RAM confirmation Number	2968
Deposit Account	160631
Authorized User	HAUN,JAMES PAUL
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		4056_02US03_AMEND.pdf	243355 5cc6cacc1946e086daddc916fb378c4341a4afa8	yes	10

	Multipart Description/PDF files in .zip description		
	Document Description	Start	End
	Extension of Time	1	1
	Amendment/Req. Reconsideration-After Non-Final Reject	2	2
	Claims	3	6
	Applicant Arguments/Remarks Made in an Amendment	7	8
	Terminal Disclaimer Filed	9	10

Warnings:

Information:

2	Fee Worksheet (PTO-875)	fee-info.pdf	31836 f25a40add413e2eab22838f8486955df46093a21	no	2

Warnings:

Information:

Total Files Size (in bytes):	275191

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:	Attorney Docket No.: 4056.02US03
Senkiw	Confirmation No.: 7381
Application No.: 12/023,431	Examiner: Cameron J. Allen
Filed: January 31, 2008	Group Art Unit: 1797
For: FLOW-THROUGH OXYGENATOR	

PETITION FOR EXTENSION OF PERIOD FOR RESPONSE
UNDER 37 CFR § 1.136(a)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Pursuant to 37 CFR § 1.136(a), an extension of time of two (2) months (from June 27, 2009 to August 27, 2009) within which to respond to the Office Action dated March 27, 2009 is requested. Electronic payment is submitted by credit card to cover the extension fee. Applicant is entitled to small entity status in accordance with 37 CFR 1.27. The Commissioner is authorized to charge to Deposit Account No. 16-0631 any underpayments, overpayments or additionally required fees.

Respectfully submitted,

J. Paul Haun
Registration No. 53,003

Customer No. 24113
Patterson, Thuente, Skaar & Christensen, P.A.
4800 IDS Center
80 South 8th Street
Minneapolis, Minnesota 55402-2100
Telephone: (612) 349-3009

Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 16-0631.

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:	Attorney Docket No.: 4056.02US03
Senkiw	Confirmation No.: 7381
Application No.: 12/023,431	Examiner: Cameron J. Allen
Filed: January 31, 2008	Group Art Unit: 1797
For: FLOW-THROUGH OXYGENATOR	

AMENDMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

INTRODUCTORY COMMENTS

In response to the Office Action of March 27, 2009, and in accordance with the automatic extension of time for response provided by 37 CFR § 1.136(a), amendment to the above-identified patent application is requested.

The present amendment comprises the following sections:

A. Listing of Claims

B. Remarks

Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 16-0631.

LISTING OF CLAIMS

A detailed listing of all claims that are, or were, in the present application, irrespective of whether the claim(s) remain(s) under examination in the application is presented below. The claims are presented in ascending order and each includes one status identifier. Those claims not cancelled or withdrawn but amended by the current amendment utilize the following notations for amendment: 1. deleted matter is shown by strikethrough for six or more characters and double brackets for five or fewer characters; and 2. added matter is shown by underlining.

1. (Original) A method for treating waste water comprising;

providing a flow-through oxygenator comprising an emitter for electrolytic generation of microbubbles of oxygen comprising an anode separated at a critical distance from a cathode and a power source all in electrical communication with each other,

placing the emitter within a conduit; and

passing waste water through the conduit.

2. (Previously Presented) An emitter for electrolytic generation of microbubbles of oxygen in an aqueous medium comprising: an anode separated at a critical distance from a cathode, a nonconductive spacer maintaining the separation of the anode and cathode, the nonconductive spacer having a spacer thickness between 0.005 to 0.050 inches such that the critical distance is less than 0.060 inches_and a power source all in electrical communication with each other, wherein the critical distance results in the formation of oxygen bubbles having a bubble diameter less than 0.0006 inches, said oxygen bubbles being incapable of breading the surface tension of the aqueous medium such that said aqueous medium is supersaturated with oxygen.

3. (Previously Presented) The emitter of claim 2, wherein the anode is a metal or a metallic oxide or a combination of a metal and a metallic oxide.

4. (Previously Presented) The emitter of claim 2, wherein the anode is platinum and iridium oxide on a support.

5. (Previously Presented) The emitter of claim 2, wherein the cathode is a metal or metallic oxide or a combination of a metal and a metallic oxide.

6. (Previously Presented) The emitter of claim 2, wherein the_critical distance is 0.005 to 0.060 inches.

7. (Previously Presented) The emitter of claim 2, comprising a plurality of anodes separated at the critical distance from a plurality of cathodes.

8. (Previously Presented) A method for oxygenating a non-native habitat for temporarily keeping aquatic animals, comprising:

inserting the emitter of claim 2 into the aqueous medium, the non-native habitat comprising an aquarium, a bait bucket or a live well.

9. (Previously Presented) A method for lowering the biologic oxygen demand of polluted water comprising:

passing the polluted water through a vessel containing the emitter of claim 2.

10. (Previously Presented). A suspersaturated aqueous product formed with the emitter of claim 2, the supersaturated aqueous product having an approximately neutral pH.

11. (Previously Presented) The emitter of claim 2, further comprising a timer control.

12. (Previously Presented) The emitter of claim 2, wherein the anode and cathode are arranged such that the emitter assumes a funnel or pyramidal shaped emitter.

REMARKS

Claims 1-12 are pending. By this Amendment, no claims are cancelled or amended, and no new claims are added.

Double Patenting

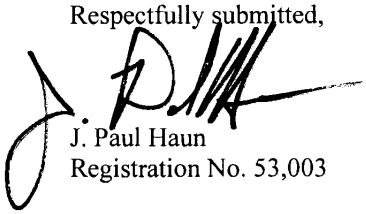
In the Office Action mailed March 27, 2009, claims 1-12 were rejected on the grounds of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-14 of commonly owned U.S. Patent No. 6,689,262, and claims 2-12 were rejected on the grounds of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-17 of commonly owned U.S. Patent No. 7,396,441. In response, Applicant includes a properly executed Terminal Disclaimer to overcome said rejections. Applicant respectfully requests said rejection be withdrawn.

In addition, claims 1-12 were provisionally rejected on the grounds of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-7 of copending Application No. 10/732,326. As discussed with the Examiner in a phone conversation on August 20, 2009, Application No. 10/732,326 previously issued as U.S. Patent No. 7,396,441. As such, there no longer remains a basis for the provisional double patenting rejection.

In view of the foregoing, it is submitted that this application is in condition for allowance. Favorable consideration and prompt allowance of the application are respectfully requested.

The Examiner is invited to telephone the undersigned if the Examiner believes it would be useful to advance prosecution.

Respectfully submitted,



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PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD
Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
12/023,431	01/31/2008	

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY ☒ RATE ($)	SMALL ENTITY ☒ FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	08/20/2009	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 12	Minus	** 20	= 0	X $26 =	0	OR	X $ =	
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $110 =	0	OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE	0	OR	TOTAL ADD'L FEE	

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)	OR	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/MARCUS PRIDGEN/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/023,431	01/31/2008	James Andrew Senkiw	4056.02US03	7381

24113 7590 03/27/2009

PATTERSON, THUENTE, SKAAR & CHRISTENSEN, P.A.
4800 IDS CENTER
80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402-2100

EXAMINER	
ALLEN, CAMERON J	
ART UNIT	PAPER NUMBER
1797	

MAIL DATE	DELIVERY MODE
03/27/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No.	Applicant(s)	
	12/023,431	SENKIW, JAMES ANDREW	
	Examiner	Art Unit	
	CAMERON J. ALLEN	1797	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 January 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *31 January 2008* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *2/21/2008, 4/4/2008*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

U.S. Patent and Trademark Office
PTOL-326 (Rev. 08-06) **Office Action Summary** Part of Paper No./Mail Date 20090225

DETAILED ACTION

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-12 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-14 of U.S. Patent No. 6,689,262 B2. Although the conflicting claims are not identical, they are not patentably distinct from each other because the instant application discloses use in a conduit, but the patent discloses use in a vessel. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the device in a conduit, since one of ordinary skill in the art would recognize it would yield the added and expected result of oxygenation.

Claims 2-12 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-17 of U.S. Patent No. 7,396,441 B2.

Although the conflicting claims are not identical, they are not patentably distinct from each other because the instant application discloses one set of anodes and cathodes and the patent discloses the use of multiple anode and cathode configuration. It would have been obvious to one of ordinary skill in the art at the time of the invention to use multiple anode and cathode configuration, since; it would yield the added benefit and expected result of increased treatment.

Claims 1-12 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-7 of copending Application No. 10/732,326. Although the conflicting claims are not identical, they are not patentably distinct from each other because the instant application discloses the critical distance is less than 0.060. The related application discloses 0.0005-0.140 and 0.045 to 0.060. One of ordinary skill in the art at the time of the invention would recognize that the ranges overlap, and therefore disclose the same distances.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CAMERON J. ALLEN whose telephone number is (571)270-3164. The examiner can normally be reached on M-Th 9-7pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Walter Griffin can be reached on 571-272-1447. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

CJA

/Walter D. Griffin/
Supervisory Patent Examiner, Art Unit 1797

Notice of References Cited	Application/Control No. 12/023,431	Applicant(s)/Patent Under Reexamination SENKIW, JAMES ANDREW	
	Examiner CAMERON J. ALLEN	Art Unit 1797	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,689,262	02-2004	Senkiw, James Andrew	204/278.5
*	B	US-7,396,441	07-2008	Senkiw, James Andrew	204/278
*	C	US-2004/0118701	06-2004	Senkiw, James Andrew	205/633
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Substitute for form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*				*Complete if Known*	
				Application Number	12/023,431
				Filing Date	January 31, 2008
				First Named Inventor	Senkiw
				Art Unit	1797
				Examiner Name	Unknown
Sheet	1	of	1	Attorney Docket Number	4056.02US03

U.S. PATENT DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document
/C.A./		US-5,148,772	09-22-1992	Kirschbaum
/C.A./		US-4,257,352	03-24-1981	Habegger
/C.A./		US-4,071,447	01-31-1978	Ramirez
		US-		
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FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	T[6]
/C.A./		WO 01/89997 A2	11-29-2001	Megaton Systems AS	
/C.A./		EP 0 723 936 A2	07-31-1996	First Ocean Co., Ltd.	
/C.A./		GB 1 522 188	08-23-1978	Swift & Company	

EXAMINER SIGNATURE	/Cameron Allen/	DATE CONSIDERED	02/25/2009

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450.**

Substitute for form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*				*Complete if Known*	
				Application Number	12/023,431
				Filing Date	January 31, 2008
				First Named Inventor	Senkiw
				Art Unit	1797
				Examiner Name	
Sheet	1	of	2	Attorney Docket Number	4056.02US03

U.S. PATENT DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document
/C.A./		US-6,689,262 B2	02-10-2004	Senkiw
/C.A./		US-2003/0164306 A1	09-04-2003	Senkiw
/C.A./		US-2002/0074237 A1	06-20-2002	Takesako et al.
/C.A./		US-6,394,429 B2	05-28-2002	Gañan-Cálvo
/C.A./		US-6,328,875 B1	12-11-2001	Zappi et al.
/C.A./		US-6,315,886 B1	11-13-2001	Zappi
/C.A./		US-6,171,469 B1	01-09-2001	Hough et al.
/C.A./		US-5,982,609	11-09-1999	Evans
/C.A./		US-5,534,143	07-09-1996	Portier et al.
/C.A./		US-5,015,354	05-14-1991	Nishiki et al.
/C.A./		US-4,587,001	05-06-1986	Cairns et al.
/C.A./		US-4,252,856	02-24-1981	Sara
/C.A./		US-4,225,401	09-30-1980	Divisek et al.
		US-		
		US-		
		US-		
		US-		
		US-		
		US-		

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	T[6]
/C.A./		WO 99/39561	08-12-1999	Mazzei	
/C.A./		WO 03/072507 A1	09-04-2003	Senkiw	

EXAMINER SIGNATURE	/Cameron Allen/	DATE CONSIDERED	02/25/2009

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Substitute for form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*				*Complete if Known*	
				Application Number	12/023,431
				Filing Date	January 31, 2008
				First Named Inventor	Senkiw
				Art Unit	1797
				Examiner Name	
Sheet	2	of	2	Attorney Docket Number	4056.02US03

NON PATENT LITERATURE DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T[2]
/C.A./		MOHYUDDIN MIRZA ET AL., "Effect of Oxygenated Water on the Growth & Biomass Development of Seedless Cucumbers and Tomato Seedlings under Greenhouse Conditions," Seair Diffusion Systems, 2003, 5 pages, www.seair.ca	

EXAMINER SIGNATURE	/Cameron Allen/	DATE CONSIDERED	02/25/2009

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1]Applicant's unique citation designation number (optional). [2]Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 120 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	19	"6689262"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/24 14:01
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S4	0	systems and methods for process stream treatment	US-PGPUB; USPAT; USOCR	ADJ	ON	2009/02/25 10:34
S5	0	pct/us2007/026219	US-PGPUB; USPAT; USOCR	ADJ	ON	2009/02/25 10:34
S6	0	pct/us07/026219	US-PGPUB; USPAT; USOCR	ADJ	ON	2009/02/25 10:34
S7	0	pctus07026219	US-PGPUB; USPAT; USOCR	ADJ	ON	2009/02/25 10:34
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S26	11	"4257352"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 13:46

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S38	229	204/554.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:05
S39	273	204/660.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:05
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S43	127	205/633.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/25 14:11
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S52	585	(205/633-638).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:04
S53	4	S52 and microbubbles	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:04
S54	0	S52 and micro adj bubbles	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:04
S55	89268	electrolysis	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:05
S56	5797	oxygenator	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:05
S57	6	S52 and S56	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2009/02/26 10:05

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12023431	SENKIW, JAMES ANDREW
	Examiner	Art Unit
	CAMERON J ALLEN	1797

SEARCHED			
Class	Subclass	Date	Examiner
210	748, 600, 243	2/25/2009	CA
204	278, 242, 243, 275.1, 232, 286.1, 554, 660,	2/25/2009	CA
205	633-638	2/26/2009	CA

SEARCH NOTES		
Search Notes	Date	Examiner
See East Search History	2/25/2009	CA
Inventor Search	2/25/2009	CA

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
	See East Search History	2/25/2009	CA

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
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BIB DATA SHEET

CONFIRMATION NO. 7381

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/023,431	01/31/2008 RULE	210	1797	4056.02US03

APPLICANTS
James Andrew Senkiw, Minneapolis, MN;

**** CONTINUING DATA ***************************
This application is a DIV of 10/732,326 12/10/2003 PAT 7,396,441
which is a CIP of 10/372,017 02/21/2003 PAT 6,689,262
which claims benefit of 60/358,534 02/22/2002

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **
02/13/2008

Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged	Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ Yes ☑ No	☐ Yes ☑ No	/CAMERON J ALLEN/ Examiner's Signature	☐ Initials	MN	8	1	1

ADDRESS
PATTERSON, THUENTE, SKAAR & CHRISTENSEN, P.A.
4800 IDS CENTER
80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402-2100
UNITED STATES

TITLE
FLOW-THROUGH OXYGENATOR

FILING FEE RECEIVED	FEES: Authority has been given in Paper	
500	No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

BIB (Rev. 05/07).

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:	Attorney Docket No.: 4056.02US03
Senkiw	Confirmation No.: 7381
Application No.: 12/023,431	Examiner: Unknown
Filed: January 31, 2008	Group Art Unit: 1797
For: FLOW-THROUGH OXYGENATOR	

PRELIMINARY AMENDMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

INTRODUCTORY COMMENTS

Prior to examination, please amend the above-identified application as follows:

The present amendment comprises the following sections:

A. Amendments to the Claims

B. Amendments to the Drawings

C. Remarks

Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 16-0631.

AMENDMENTS TO THE CLAIMS

A detailed listing of all claims that are, or were, in the present application, irrespective of whether the claim(s) remains under examination in the application are presented below. The claims are presented in ascending order and each includes one status identifier. Those claims not cancelled or withdrawn but amended by the current amendment utilize the following notations for amendment: 1. deleted matter is shown by strikethrough; and 2. added matter is shown by underlining.

1. A method for treating waste water comprising;

providing a flow-through oxygenator comprising an emitter for electrolytic generation of microbubbles of oxygen comprising an anode separated at a critical distance from a cathode and a power source all in electrical communication with each other,

placing the emitter within a conduit; and

passing waste water through the conduit.

Please add new claims 2-14 as follows:

2. (New) An emitter for electrolytic generation of microbubbles of oxygen in an aqueous medium comprising: an anode separated at a critical distance from a cathode, a nonconductive spacer maintaining the separation of the anode and cathode, the nonconductive spacer having a spacer thickness between 0.005 to 0.050 inches such that the critical distance is less than 0.060 inches and a power source all in electrical communication with each other, wherein the critical distance results in the formation of oxygen bubbles having a bubble diameter less than 0.0006 inches, said oxygen bubbles being incapable of breading the surface tension of the aqueous medium such that said aqueous medium is supersaturated with oxygen.

3. (New) The emitter of claim 2, wherein the anode is a metal or a metallic oxide or a combination of a metal and a metallic oxide.

4. (New) The emitter of claim 2, wherein the anode is platinum and iridium oxide on a support.

5. (New) The emitter of claim 2, wherein the cathode is a metal or metallic oxide or a combination of a metal and a metallic oxide.

6. (New) The emitter of claim 2, wherein the critical distance is 0.005 to 0.060 inches.

7. (New) The emitter of claim 2, comprising a plurality of anodes separated at the critical distance from a plurality of cathodes.

8. (New) A method for oxygenating a non-native habitat for temporarily keeping aquatic animals, comprising:

inserting the emitter of claim 2 into the aqueous medium, the non-native habitat comprising an aquarium, a bait bucket or a live well.

9. (New) A method for lowering the biologic oxygen demand of polluted water comprising:

passing the polluted water through a vessel containing the emitter of claim 2.

10. (New). A suspersaturated aqueous product formed with the emitter of claim 2, the supersaturated aqueous product having an approximately neutral pH.

11. (New) The emitter of claim 2, further comprising a timer control.

12. (New) The emitter of claim 2, wherein the anode and cathode are arranged such that the emitter assumes a funnel or pyramidal shaped emitter.

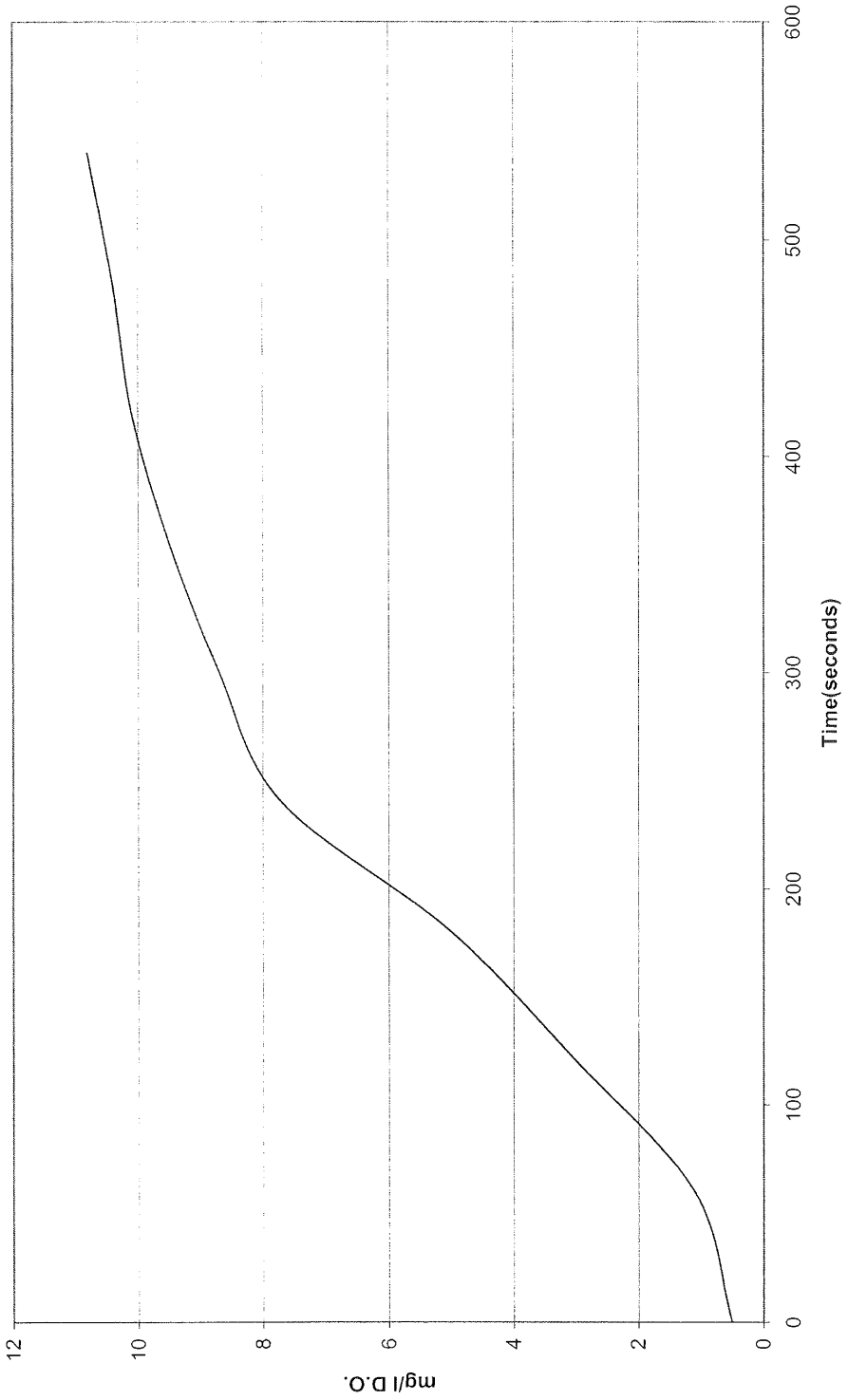

Fig. 8 Time vs D.O.

Electronic Acknowledgement Receipt	
EFS ID:	4467093
Application Number:	12023431
International Application Number:	
Confirmation Number:	7381
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	24113
Filer:	J. Paul Haun/Valerie Mitchell
Filer Authorized By:	J. Paul Haun
Attorney Docket Number:	4056.02US03
Receipt Date:	16-DEC-2008
Filing Date:	31-JAN-2008
Time Stamp:	16:57:13
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		4056_02US03_PREL_AMEND.pdf	672037 5d7fd6ac771f161089c835db0e132c8c8b4506cd	yes	8

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	1
	Claims	2	5
	Drawings-only black and white line drawings	6	6
	Applicant Arguments/Remarks Made in an Amendment	7	7
	Drawings-only black and white line drawings	8	8
Warnings:			
Information:			
	Total Files Size (in bytes):	672037	

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

AMENDMENTS TO THE DRAWINGS

Replacement Figure 8 depicts the dissolved oxygen versus time data described at Page 19, Lines 9-13.

Attachment: One Replacement Sheet including Replacement Figure 8.

REMARKS

Claim 1 is pending. By this Amendment, new claims 2-12 are added. Support for these newly added claims can be found throughout the application as originally filed. In addition, one Replacement Sheet including Replacement Figure 8 has been submitted for purposes of properly illustrating the dissolved oxygen versus time data described at Page 19, Lines 9-13 of the application as originally filed.

In view of the foregoing, it is submitted that this application is in condition for allowance. Favorable consideration and prompt allowance of the application are respectfully requested.

The Examiner is invited to telephone the undersigned if the Examiner believes it would be useful to advance prosecution.

Respectfully submitted,

J. Paul Haun
Registration No. 53,003

Customer No. 24113
Patterson, Thuente, Skaar & Christensen, P.A.
4800 IDS Center
80 South 8th Street
Minneapolis, Minnesota 55402-2100
Telephone: (612) 349-3009

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD
Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
12/023,431	01/31/2008	

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY ☒ RATE ($)	SMALL ENTITY ☒ FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	12/16/2008	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 12	Minus	** 20	= 0	X $26 =	0	OR	X $ =	
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $110 =	0	OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE	0	OR	TOTAL ADD'L FEE	

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)	OR	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/VENICE M. WILLIAMS/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/023,431	01/31/2008	James Andrew Senkiw	4056.02US03

CONFIRMATION NO. 7381

24113
PATTERSON, THUENTE, SKAAR & CHRISTENSEN, P.A.
4800 IDS CENTER
80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402-2100

PUBLICATION NOTICE

Date Mailed: 07/31/2008

Title:FLOW-THROUGH OXYGENATOR

Publication No.US-2008-0179259-A1
Publication Date:07/31/2008

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/023,431	01/31/2008	1797	500	4056.02US03	1	1

CONFIRMATION NO. 7381

UPDATED FILING RECEIPT

24113
PATTERSON, THUENTE, SKAAR & CHRISTENSEN, P.A.
4800 IDS CENTER
80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402-2100

OC000000029433262

Date Mailed: 04/18/2008

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Filing Receipt Corrections. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

James Andrew Senkiw, Minneapolis, MN;

Assignment For Published Patent Application

AQUA INNOVATIONS, INC., Minnetonka, MN

Power of Attorney: The patent practitioners associated with Customer Number 24113

Domestic Priority data as claimed by applicant

This application is a DIV of 10/732,326 12/10/2003
which is a CIP of 10/372,017 02/21/2003 PAT 6,689,262
which claims benefit of 60/358,534 02/22/2002

Foreign Applications

If Required, Foreign Filing License Granted: 02/13/2008

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/023,431**

Projected Publication Date: 07/31/2008

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****

Title

FLOW-THROUGH OXYGENATOR

Preliminary Class

210

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

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Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of: Attorney Docket No.: 4056.02US03

Senkiw Confirmation No.: 7381

Application No.: 12/023,431 Examiner: Unknown

Filed: January 31, 2008 Group Art Unit: 1797

For: FLOW-THROUGH OXYGENATOR

RESPONSE TO NOTICE TO FILE MISSING PARTS
OF NONPROVISIONAL APPLICATION

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Notice to File Missing Parts of Application - Filing Date Granted mailed February 15, 2008, submitted herewith are a copy of the Combined Declaration and Power of Attorney, Substitution of Attorney and Certificate Under 37 CFR § 3.73(b), and a PAIR printout showing the Correspondence Address and Attorney/Agent Information from parent Application No. 10/732,326, and two sheets of replacement drawings.

The filing fee has been calculated as shown below:

Application filed on or after December 8, 2004:					
	No. Filed	No. Extra	Small Entity Rate	OR	Large Entity Rate
Basic Filing Fee			$75	OR	$310
Utility Search Fee			$255	OR	$510
Utility Examination Fee			$105	OR	$210
Total Claims	1 - 20	= 0**	x 25 = $	OR	x 50 = $
Independent Claims	1 - 3	= 0**	x 105 = $	OR	x 210 = $
Presence of Multiple Dependent Claim			+ 185	OR	+ 370
Surcharge - Late filing fee or oath or declaration			+ 65	OR	+ 130
Utility Application Size Fee - per each additional 50 sheets that exceeds 100 sheets:			x 130 = $	OR	x 260 = $
		TOTAL	**$500**	**TOTAL**	**$**
**If the difference is less than zero, enter "0". Total # of sheets = (Spec and Abst pgs)+Dwg Sheets					

Applicant is entitled to small entity status in accordance with 37 CFR 1.27. Please charge the $500.00 surcharge and filing fee to Deposit Account No. 16-0631. The Commissioner is hereby authorized to grant any extensions of time and to charge any fees under 37 C.F.R. §§ 1.16 and 1.17 that may be required during the entire pendency of this application to Deposit Account No. 16-0631.

Entry of these documents should complete all of the filing formalities and fully satisfy all requirements of the Notice to File Missing Parts. Accordingly, examination and allowance of this application in due course are respectfully solicited.

The Commissioner is hereby authorized to charge any underpayment or credit any overpayment to Deposit Account No. 16-0631.

Respectfully submitted,

J. Paul Haun
Registration No. 53,003

Customer No. 24113
Patterson, Thuente, Skaar & Christensen, P.A.
4800 IDS Center
80 South 8th Street
Minneapolis, Minnesota 55402-2100
Telephone: (612) 349-3009

Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 16-0631.

UNITED STATES PATENT APPLICATION

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name:

I verily believe that I am the original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: **FLOW-THROUGH OXYGENATOR** the specification for which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with 37 C.F.R § 1.56. I also acknowledge my duty to disclose all information known to be material to patentability which became available between a filing date of a prior application and the national or PCT filing date in the event this is a Continuation-in-Part application in accordance with 37 C.F.R. § 1.63(e).

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below:

Application Number	**Filing Date**
60/431,577	02/22/2002

I hereby claim the benefit under 37 C. F.R. § 1.63(E) of any United States provisional application(s) listed below:

Application Number	**Filing Date**
10/372,017	02/21/2003

I hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith:

Terry, Kathleen R.	Reg.No. 31884
McTavish, Hugh	Reg. No. 48341

Please direct all correspondence in this case to:

Kathleen R. Terry
2417 Como Avenue
St. Paul, MN 55108-1459
651-659-9819
Krterry@visi.com
FAX 651 603 1809

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application issued thereon.

Full name of sole inventor number:

Citizenship: United States of America

Residence Address: James Andrew Senkiw
4750 Aldrich Avenue North
Minneapolis, MN 55430-3529

Signature: _____ Date: 12/5/03

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:	Attorney Docket No.: 4056.02US01
James Andrew Senkiw	Confirmation No.: 7020
Application No.: 10/732,326	Examiner: Zheng, Lois L.
Filed: December 10, 2003	Group Art Unit: 1742
For: FLOW-THROUGH OXYGENATOR	

SUBSTITUTION OF ATTORNEY

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I hereby appoint the practitioners associated with **Customer Number 24113** to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Address all telephone calls to: J. Paul Haun at telephone number (612) 349-3009.

Address all correspondence to:

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Application No. 10/732,326

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All previous powers of attorney granted in this case are hereby revoked.

Aqua Innovations, Inc., Assignee

Date: 8-15-07

Signature

Richard L. Disrud

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Title

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of: Attorney Docket No.: 4056.02US01

James Andrew Senkiw Confirmation No.: 7020

Application No.: 10/732,326 Examiner: Zheng, Lois L.

Filed: December 10, 2003 Group Art Unit: 1742

For: FLOW-THROUGH OXYGENATOR

CERTIFICATE UNDER 37 CFR § 3.73(b)

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Electronic Patent Application Fee Transmittal	
Application Number:	12023431
Filing Date:	31-Jan-2008
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Filer:	J. Paul Haun/Valerie Mitchell
Attorney Docket Number:	4056.02US03
Filed as Small Entity	

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	75	75
Utility Search Fee	2111	1	255	255
Utility Examination Fee	2311	1	105	105
Pages:				
Claims:				
Miscellaneous-Filing:				
Late filing fee for oath or declaration	2051	1	65	65
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**500**

Electronic Acknowledgement Receipt	
EFS ID:	3125353
Application Number:	12023431
International Application Number:	
Confirmation Number:	7381
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	24113
Filer:	J. Paul Haun/Valerie Mitchell
Filer Authorized By:	J. Paul Haun
Attorney Docket Number:	4056.02US03
Receipt Date:	09-APR-2008
Filing Date:	31-JAN-2008
Time Stamp:	13:12:06
Application Type:	Utility under 35 USC 111(a)

Payment information:

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Payment Type	Deposit Account
Payment was successfully received in RAM	$500
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Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)
1		4056_02US03_RESMP.pdf	996295 2bb432eac8602d7fb683a0da2de44983ec475de2	yes	12

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	Document Description	**Start**	**End**
	Applicant Response to Pre-Exam Formalities Notice	1	2
	Oath or Declaration filed	3	10
	Drawings-only black and white line drawings	11	12

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2	Fee Worksheet (PTO-06)	fee-info.pdf	8509 6cb06ac06792a927b1c0917c83e326a18e9e2472	no	2

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Electronic Acknowledgement Receipt	
EFS ID:	3125353
Application Number:	12023431
International Application Number:	
Confirmation Number:	7381
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	24113
Filer:	J. Paul Haun/Valerie Mitchell
Filer Authorized By:	J. Paul Haun
Attorney Docket Number:	4056.02US03
Receipt Date:	09-APR-2008
Filing Date:	31-JAN-2008
Time Stamp:	13:12:06
Application Type:	Utility under 35 USC 111(a)

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Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)
1		4056_02US03_RESMP.pdf	996295 2bb432eac8602d7fb683a0da2de44983ec475de2	yes	12

Multipart Description/PDF files in .zip description

Document Description	Start	End
Applicant Response to Pre-Exam Formalities Notice	1	2
Oath or Declaration filed	3	10
Drawings-only black and white line drawings	11	12

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2	Fee Worksheet (PTO-06)	fee-info.pdf	8509 6cb06ac06792a927b1c0917c83e326a18e9e2472	no	2

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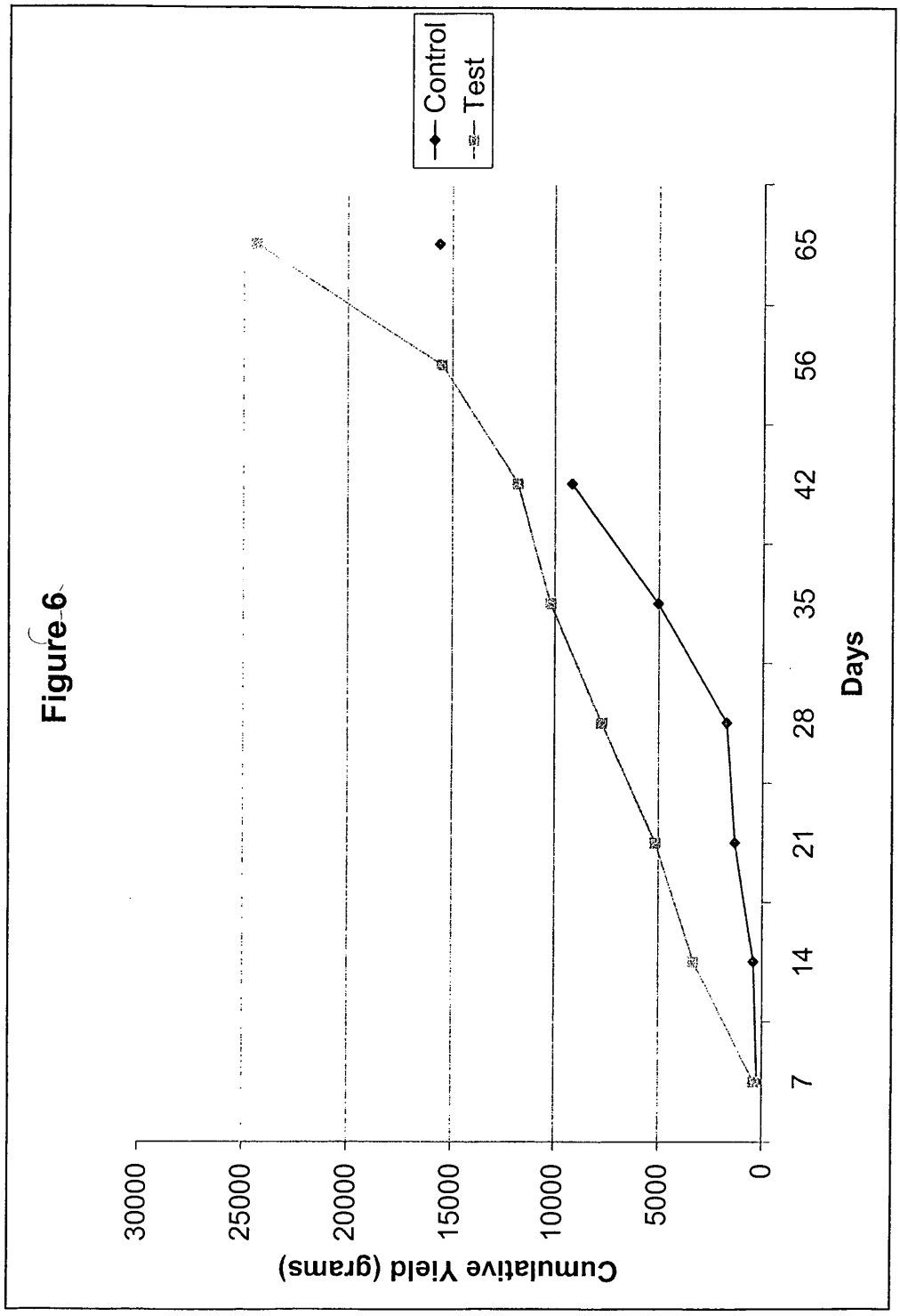

Control
Test
Cumulative Yield (grams)
30000
25000
20000
15000
10000
5000
0
Days
7
14
21
28
35
42
56
65

Figure 6

Fig. 7A

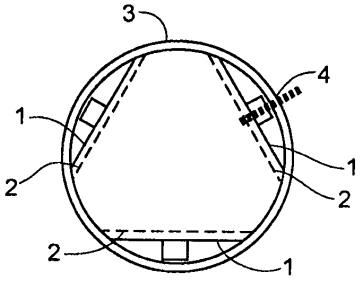
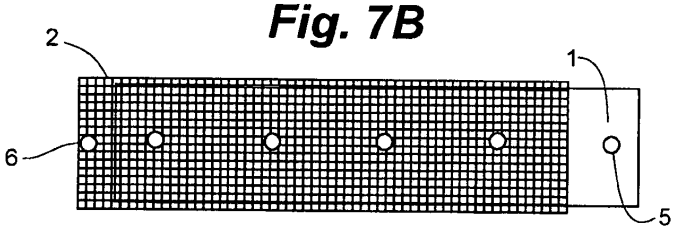


Fig. 7B



PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:	Attorney Docket No.: 4056.02US03
Senkiw	Confirmation No.: 7381
Application No.: 12/023,431	Examiner: Unknown
Filed: January 31, 2008	Group Art Unit: 1797
For: FLOW-THROUGH OXYGENATOR	

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
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P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Pursuant to 37 CFR § 1.56, and in addition to information disclosed in Applicant's Information Disclosure Statement filed February 21, 2008, the attention of the Patent and Trademark Office is hereby directed to the references listed on the attached Form PTO-1449. It is respectfully requested that the information be expressly considered during the prosecution of this application, and that the references be made of record therein and appear among the "References Cited" on any patent to issue therefrom. The listing of a reference herein is not an admission that the reference is prior art or that the reference is material to patentability.

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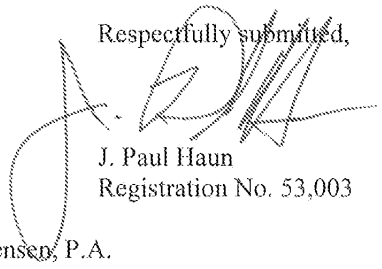
Respectfully submitted,



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Substitute for form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*				*Complete if Known*	
				Application Number	12/023,431
				Filing Date	January 31, 2008
				First Named Inventor	Senkiw
				Art Unit	1797
				Examiner Name	Unknown
Sheet	1	of	1	Attorney Docket Number	4056.02US03

U.S. PATENT DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document
		US-5,148,772	09-22-1992	Kirschbaum
		US-4,257,352	03-24-1981	Habegger
		US-4,071,447	01-31-1978	Ramirez
		US-		
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FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	T[6]
		WO 01/89997 A2	11-29-2001	Megaton Systems AS	
		EP 0 723 936 A2	07-31-1996	First Ocean Co., Ltd.	
		GB 1 522 188	08-23-1978	Swift & Company	

EXAMINER SIGNATURE		DATE CONSIDERED	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
29 November 2001 (29.11.2001)

PCT

(10) International Publication Number
WO 01/89997 A2

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(30) Priority Data:
20002456 11 May 2000 (11.05.2000) NO

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(75) Inventor/Applicant *(for US only)*: **VÅGNES, Magne** [NO/NO]; Nymarkveien 29, N-6030 Langevåg (NO).

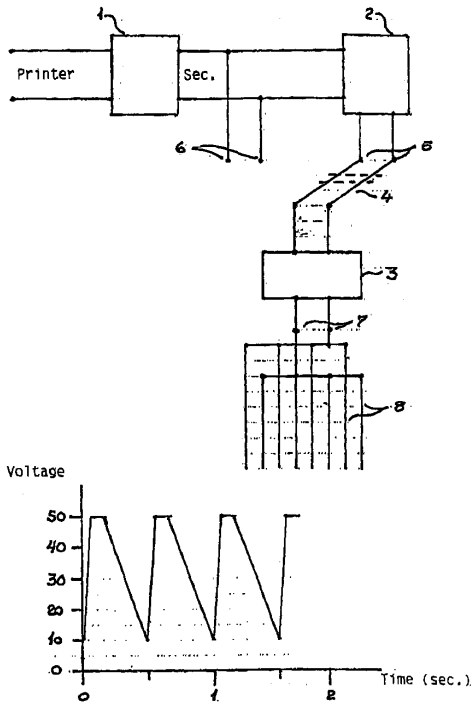
(74) Agents: **ONSAGERS AS** et al.; P.O. Box 265 Sentrum, N-0103 Oslo (NO).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: A DEVICE FOR TREATING WATER



(57) Abstract: The present invention relates to a device for treating water, e.g. for use in connection with fish farming, such as for hatching hard roe, for fish in cages, for slaughter of fish and for transport of fish. The device may also be employed in connection with other things than fish. The device comprises electrodes between which the water passes. The electrodes are made of material with high specific resistance. The electrodes are supplied with pulsed alternating or direct voltage and the electrodes are made of a material with high specific resistance.

WO 01/89997 A2

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A device for treating water

The present invention relates to a device for treating water, e.g. for use in connection with fish farming, such as for hatching hard roe, for fish in cages, for slaughter of fish and for transport of fish. The device may also be employed in connection with other things than fish. The device comprises electrodes between which the water passes. The electrodes are made of a material with high specific resistance. The electrodes are supplied with pulsed direct or alternating voltage.

THE STATE OF THE ART

A number of different systems are known for water treatment as well as for providing special favourable conditions, e.g. in connection with cultivation of plants or fish farming. These forms of water treatment, however, have either been too complicated and expensive or have not been sufficiently efficacious. It is therefore an object of the invention to provide a simpler and better method and device for water treatment, which provide an alteration in the quality or composition of the water, thus having a positive effect in connection with the use of the water. This object is achieved by the features set forth in the patent claims.

The main feature of the device according to the invention is that a voltage is supplied by means of an electrode set, which may be designed in many different ways to suit the specific area of application. Broadly speaking, the electrodes are a conductive material, which may, for example, form a part of a cage. A semiconductor material may also be used as a conductor. The most expedient method is to arrange the voltage with the positive connection on the net of the actual cage and the negative connection is arranged on a device in or on the outside of the cage.

The voltage may also be altered permanently or alternately in the opposite direction. A reversal of the current direction may also be employed in order to remove coating which has been deposited on the cage or the positive conductor as a result of the current flow.

When designing the system, a choice may be made between the following alternatives:

1. Fixed voltage or regular or irregular voltage pulses/sequence waves of current.

2. A combination of fixed low voltage (for example 2V) and stronger pulses (50V).
3. Voltages in the range 0.1 to 100 volts.

When applying a fixed voltage, it should be understood that this may either be permanently on, interrupted at regular or irregular intervals or combined with a pulsed current. The choice is made on the basis of the local conditions with regard to fouling, sea currents, etc.

The device according to the invention is especially intended for the following applications:

1. Preventing the growth of algae by being deposited on the nets in fish cages.
2. Use in safety nets round one or more cages, where one net is supplied with negative voltage and the other net with positive voltage. Safety nets are normally used to prevent fish escaping, or to prevent attack from outside by, for example, seals, sharks, etc.
3. Preventing the growth of algae on cables, rope and moorings. Fouling problems on moorings are a well-known problem, as is fouling on cables used in seismic surveys.

A PRESENTATION OF THE INVENTION AND A DESCRIPTION OF THE DRAWING FIGURES

The invention will now be described in more detail with reference to drawings which illustrate embodiments of the invention and which are not limiting for the concept of the invention.

Fig. 1 is a connection diagram for the device.

Fig. 2 illustrates voltage measured between electrodes in sea water as a function of time.

Fig. 3 illustrates a vessel for hatching hard roe.

Fig. 4 illustrates the net in a fish farming cage.

Fig. 5 illustrates a vessel for purification of water.

Fig. 6 illustrates a vessel for production of ice.

Fig. 1 depicts a connection diagram for a device for treating water where 1 is a transformer which is connected on the primary side to mains voltage, usually 230 volts. The secondary voltage can be regulated either step by step or

continuously to the desired voltage and supplied to a rectifier 2. A pulse former 3 may be supplied with direct voltage from rectifier 2 through a reverser 4, which is then connected to connection points 5. The pulse former 3 may also be supplied with alternating voltage and the reverser 4 is then connected to connection points 6. The pulse former 3 converts the direct voltage or alternating voltage to pulses, and the number of pulses per second can be regulated. Electrodes 8 are supplied with voltage from the pulse former 3 through connection points 7. The electrodes 8 are placed in water, usually sea water, and the number and dimensions of the electrodes are determined by the area of application.

The electrodes 8 are supplied with pulsed voltage. The voltage's amplitude can be regulated from 0.1 volts up to the level which is permitted in the country where the device is to be used. According to "The Regulations for Electrical Installations", 48 volts direct voltage and alternating voltage are the highest voltage which are allowed to be used outdoors in Norway. Indoors, and e.g. in closed, insulated containers, higher voltage can be employed. The device may be built in such a manner that, e.g., it covers the voltage range from 0.1 to 1000 volts.

The number of pulses per second supplied to the electrodes 8 may be regulated within wide limits, e.g. from 1 pulse per 24 hours to 1000 pulses per second. Use is preferably made of from 0.1 to 10 pulses per second.

The electrodes 8 are made of a material with high specific resistance and normally designed as filaments or bands with specific dimensions which are adapted to suit the area of application. The specific resistance in the electrodes may be in the range from 0.01 to 100 Ω cm, preferably in the range from 5 to 10 Ω cm. As electrode materials use may be made of so-called semiconductor materials which have a specific resistance in the range between good electrical conductors and the insulator. These include silicon carbide and carbon. Such semiconductor materials can also be produced from various organic materials to which conductive particles are added.

For use in fish farming there have been developed flexible electrodes of silicon caoutchouc to which are added electrically conductive particles such as carbon particles. As core filament in such electrodes use can be made of carbon fibre. It has been found that by using electrodes with high specific resistance to which pulsed voltage is supplied, this combination provides a voltage between

the electrodes which has variable amplitude, in addition to which the voltage does not drop to 0 between each voltage pulse. This is one of the advantages of the invention.

Fig. 2 illustrates the voltage measured between electrodes in sea water as a function of time. Here the voltage is set at 48 volts direct voltage and the pulse frequency is set at 2 pulses per second. As the figure shows, a variable voltage is obtained between the electrodes, in addition to which the voltage does not drop to 0 between each pulse.

By means of the device, free ions are introduced into water passing between the electrodes. The variable voltage between the electrodes causes several different ions and combinations of ions to be easily formed in sea water, and a number of chemical substances are precipitated. On analysis of gas bubbles from sea water the following ions and substances have been found: hydroxyl ions, hypochlorite ions, oxygen, hydrogen, chlorine, ozone and hydrogen hyperoxide.

The combination of the electrode design to which pulsed voltage is supplied results in the formation of small, atomised gas bubbles in the water, thus ensuring rapid and efficient absorption of ions and substances in the water. This is an advantage of the invention. The voltage supplied to the electrodes and the number of pulses per second determine the intensity of the gas development and which substances are preferably formed. This is a further advantage of the invention. When higher voltage is supplied to the electrodes, the development of chlorine gas, e.g., increases. The above-mentioned ions and substances have a disinfectant effect on the sea water and also have positive effects on the health of the fish over the entire cycle of aquaculture from roe, larva/yolk sac, fry, smolt, small fish, large fish.

Fig. 3 illustrates a container such as a vessel 1 for hatching roe from fish, shellfish, mussels and similar marine organisms. The vessel 1 has an inlet 2 for sea water 8 near the bottom of the vessel 1, and an outlet 3 near the top of the vessel 1. The bottom of the vessel 1 is covered by a thick layer of sand 4, and the roe 5 which have to be hatched are placed on the sand layer 4. Electrodes 6 are placed in the sand 4 and covered by a sand layer 4. Two or more electrodes 6 are placed side by side and the electrodes 6 are connected alternately to positive and negative voltage. Such electrodes 6 may preferably be attached to a frame 7, which is made of an electrically insulating material such as plastic.

The frame 7 is illustrated in a separate drawing and can be placed horizontally or vertically in the vessel 1. The spacing between the electrodes 6 may be from 5 to 100 mm, preferably from 10 to 50 mm.

For hatching roe, the electrodes 6 are preferably supplied with pulsed direct voltage. Sea water 8 is pumped into the vessel 1 through the sand layer 4, and ions and substances which are formed in the sea water 8 when the electrodes 6 are supplied with pulsed direct voltage have a disinfectant effect on the sea water 8 and have a positive effect on the health of the fish. Fungal and bacterial growth in the water are prevented, thus improving the fertilisation and hatching of the eggs and reducing "failure" and malformation of the fry. In addition the oxygen content in the water will develop larger gills and larger lower jaws even at the yolk sac stage. Larger gills are important for oxygen absorption of fry and fish and larger lower jaws are important for absorption of feed. These advantages cause the fish fry to grow more rapidly in sea water treated according to the invention and are one of the advantages of the invention.

Fig. 4 illustrates parts of the net 1 in a fish farm cage. To the net 1 are attached electrodes 2. The electrodes 2, which are flexible, can either be braided into the mesh of the net 1 or attached to the mesh in the net 1 in the known manner, and can be alternately connected to positive and negative voltage. In a preferred embodiment the electrodes 2, which are braided into the mesh of the net 1 or attached to the mesh in the net 1, are connected to positive voltage. An electrode 3, which is connected to negative voltage, is placed under the net 1. This electrode 3 may, e.g., be in spiral form or folded so as to provide a sufficiently large surface, or it may be in the form of a wide band.

Ions and substances which are formed in the sea water when the electrodes 2, 3 are supplied with pulsed voltage have a disinfectant effect on the sea water and in addition have a positive effect on the health of the fish in the cage, increasing their ability to thrive and prosper. The disinfectant water will prevent fouling of the net. In addition it will prevent the intrusion into the cage of poisonous algae, jellyfish chains, fungi and other organisms which are harmful to the fish. This is one of the advantages of the invention.

In a fish farm cage the electrodes will preferably be supplied with high voltage amplitudes. Experiments have shown that it is a combination of the electric field between the electrodes and the disinfectant effect of ions and substances

formed in the sea water which have the greatest bactericidal effect. Such bacteria will become attached to a net and form a slimy layer.

In growing vessels for smolt the water must be cleaned of feed remnants and faeces. In the same way, after slaughter of fish the water must be cleaned of blood and waste particles.

Fig. 5 illustrates a container such as a vessel 1 for purifying water 8. The vessel 1 has an inlet 2 for water near the bottom of the vessel 1 and an outlet 3 near the top of the vessel 1. In the bottom of the vessel 1 there is provided a channel 4, in which there is placed a sludge pump 5, which may be in the form of a screw. Two or more electrodes 6 are placed in the vessel 1, and the electrodes 6 are alternately connected to positive and negative voltage. The electrodes 6 may be laid along the bottom of the vessel or attached to a frame 7, which is made of an electrically insulating material such as plastic. A frame 7 with electrodes 6 is illustrated in fig. 3. One or more frames 7 may be placed either horizontally or vertically in the vessel 1.

When the electrodes 6 are supplied with pulsed voltage, ions and substances are formed in the water 8, thus providing a disinfectant effect and preventing the growth of bacteria and fungi. For deposition of particles in the water a silicide is added, e.g. a silicate such as sodium silicate. The device may be used for purifying and depositing particles in process water from the fishing industry where sea water is used for purification of process water from industry, agriculture and housekeeping where fresh water is employed. To fresh water are added salts such as sodium chloride or sea water in order to increase the conductivity and to form chlorine gas.

During transport of fish, the fish is cooled to a temperature near freezing point in order to increase the lasting quality of the fish flesh. As a coolant during transport ice is normally used. Experiments have shown that ice produced from sea water in vessels where electrodes according to the invention are placed and where the electrodes are supplied with pulsed voltage, will absorb gases and substances which are formed in the sea water. Ice produced in this manner contains trapped gas bubbles and has a milky consistency. When such ice melts, it will emit the trapped gases.

Fig. 6 illustrates a container such as a vessel for production of ice according to the invention. The vessel 1 is equipped with one or more refrigerating/freezing elements 2, and is supplied with sea water 8 through inlet 3 placed near the

bottom of the vessel 1, and an outlet 4 may be located near the top of the vessel. Electrodes 5 are placed in the vessel 1 and supplied with pulsed voltage. Two or more electrodes 5 are placed side by side and the electrodes 5 are connected alternately to positive and negative voltage. In a preferred embodiment the electrodes 5 are attached to a frame 7, which is made of an electrically insulating material such as plastic, and which is illustrated in fig. 3. The cooling/freezing elements 2 are designed in such a manner that the water is frozen into ice in blocks and the dimensions of the blocks can be adapted to suit the purpose. Sea water 8 is pumped into the vessel through inlet 3. When the sea water 8 passes between the electrodes 5, ions and substances will be formed as gas bubbles in the water. The gas bubbles will be trapped in the ice which is produced. This is an advantage of the invention.

In the same way as ions and substances formed in sea water treated according to the invention have a disinfectant effect on the sea water, experiments show that ice produced according to the invention also has a disinfectant effect. When fish is refrigerated, such ice, in addition to cooling the fish, will also emit gases which provide a disinfectant effect, thus extending the lasting quality of the fish flesh. This is one of the advantages of the invention. By using ice produced according to the invention, experiments show that the amount of ice can be reduced substantially compared to the use of untreated ice. A reduction of 85% in weight of coolant can be achieved. This means a considerable reduction in the transport weight and provides major savings in freight costs.

Many modifications both with regard to type of voltage and design of electrodes are possible within the scope of the invention. With regard to the use of pulsed direct voltage, both voltage variations and intermittent voltage supply may be involved.

PATENT CLAIMS

1. A device for treating water comprising electrodes between which the water passes, especially for use in connection with fish farming, such as in hatching of hard roe, fish in cages, slaughter of fish and transport of fish, characterized in that the electrodes are supplied with a fixed and/or pulsed alternating or direct voltage and that the electrodes are made of a material with high specific resistance.

2. A device according to claim 1, characterized in that the electrodes are supplied with alternating or direct voltage in the range 0.1 to 1000 volts, preferably in the range 0.5 to 50 volts and possibly with between 0.00001 and 1000 pulses per second, preferably between 0.1 and 10 pulses per second.

3. A device according to claims 1 and 2, characterized in that the spacing between the electrodes is from 1mm to 100000mm, preferably from 5mm to 500mm.

4. A device according to claims 1-3, characterized in that the electrodes' resistance is between 0.01 to 100Ω cm, preferably between 5 and 10Ω cm.

5. A device according to claims 1-4, characterized in that the electrodes are made of silicon caoutchouc to which is added conductive particles such as carbon particles or carbon fibre.

6. A device according to claims 1-5 for use in vessels for hatching hard roe where the vessel has an inlet and an outlet for water and where the bottom of the vessel is covered by a sand layer and where roe are placed on the sand layer, characterized in that two or more electrodes are placed in the sand layer and covered by sand, that the electrodes are supplied with pulsed direct voltage and that water which is introduced at the bottom of the vessel passes through the sand layer and between the electrodes and is discharged at the top of the vessel.

7. A device according to claims 1-5 for use in fish farm cages where a net encloses the cage and forms a bottom, characterized in that one or more electrodes connected to positive voltage are

braided into and/or attached to the net and that one or more electrodes connected to negative voltage are placed at the bottom of the net.

8. A device according to claims 1-5 for use in vessels for purification of water during slaughter of fish, where the vessel has an inlet and an outlet for water,
characterized in that two or more electrodes are placed in the vessel and that a silicide, e.g. a silicate is added for depositing particles in the water and that sea water is introduced at the bottom of the vessel and discharged at the top of the vessel.

9. A device according to claims 1-5 for use in vessels for the production of ice where the vessel has an inlet and an outlet for water and where the vessel is designed with one or more cooling/freezing elements,
characterized in that two or more electrodes are placed in the vessel and that the electrodes are supplied with pulsed direct voltage during the freezing period.

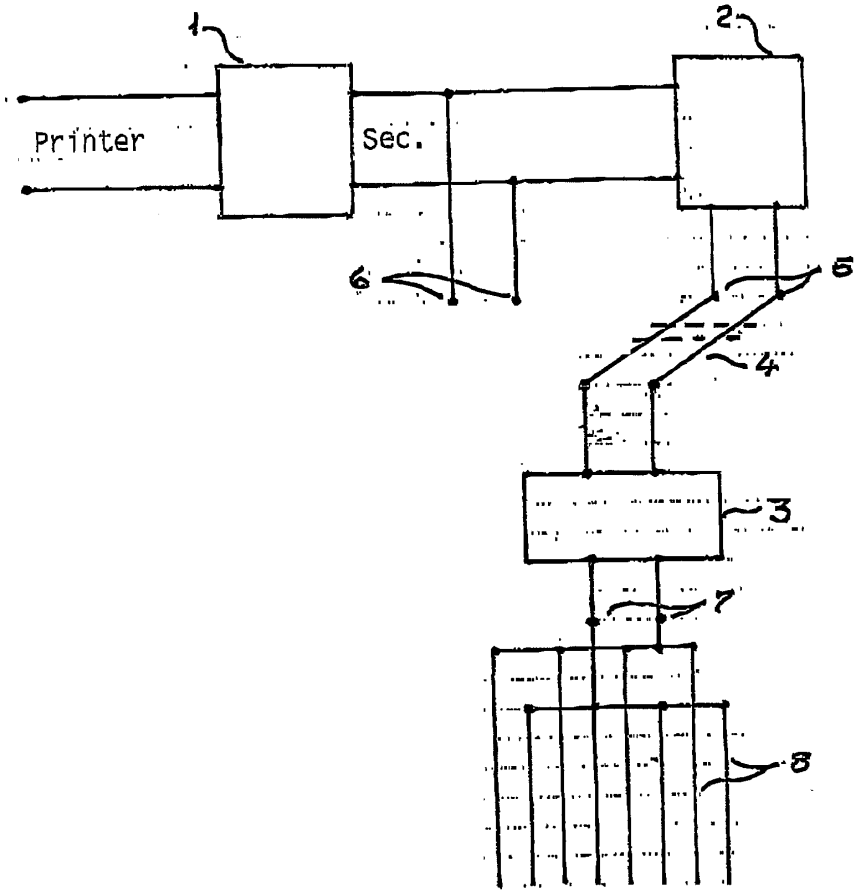


Fig. 1

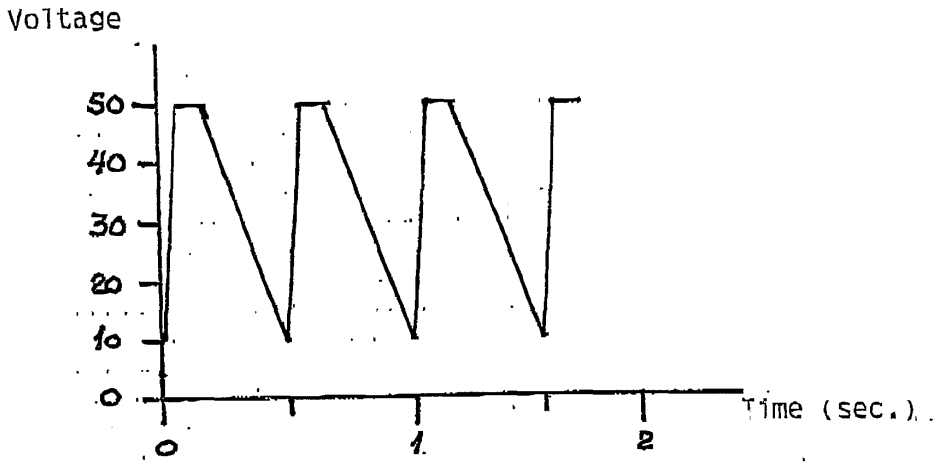


Fig. 2

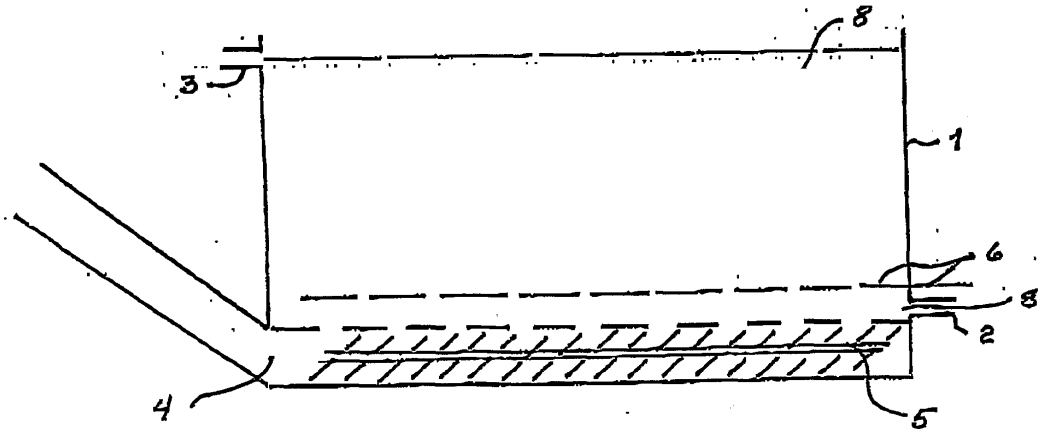
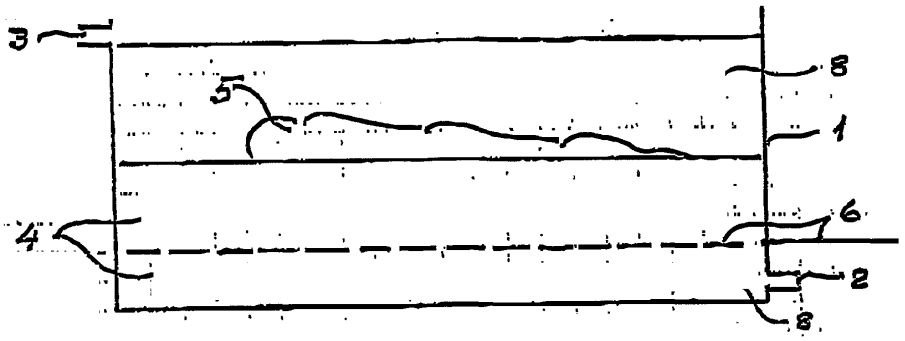


Fig. 5



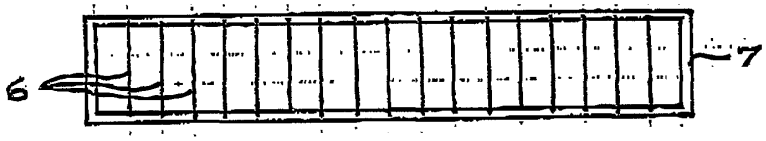


Fig. 3

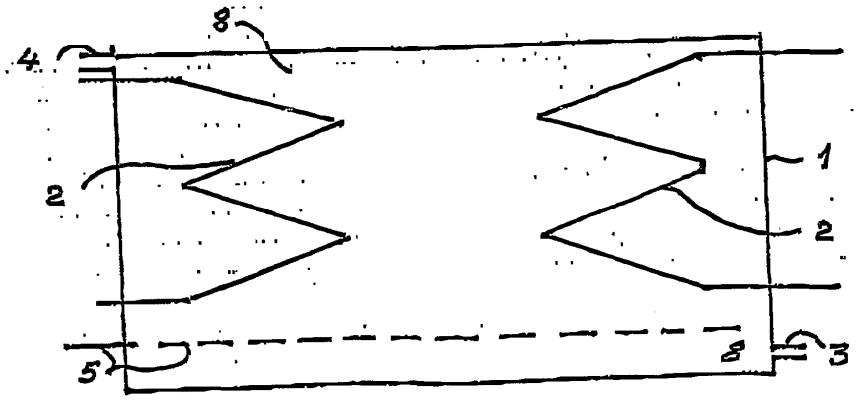


Fig. 6

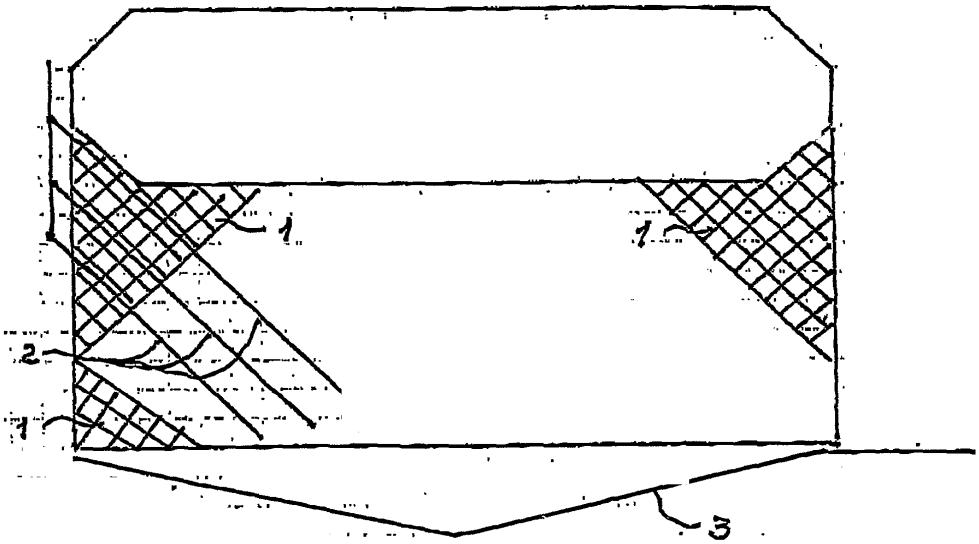


Fig. 4

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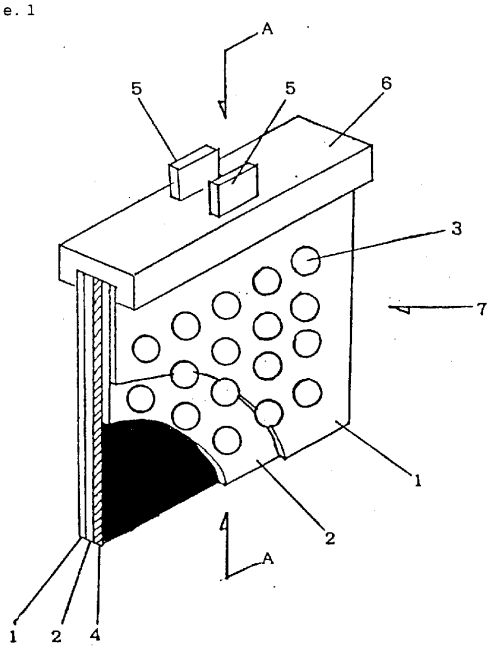
(54) **A composite electrode construction for electrolysis of water**

(57) This invention relates to a composite electrode (7) for electrolysis of water, which is comprised of a panel of which one surface (1) is made from electrically conductive material and another surface (2) is made from non-electrically conductive material. A plurality of holes (3) are bored through said panel, and two said panels are arranged so as to hold a diaphragm (4) between the surface (2) of non-electric conductive material of each panel. The electrolysis reaction occurs at the outer side of the anode and cathode of said composite electrode (7).

Figure. 1



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Description

This invention relates to an electrode which is used for electrolysis of water or water which includes electrolytes, and more particularly relates to an electrode for electrolysis to produce acid and alkaline ionized water.

A method to produce acid and alkaline ionized water by electrolysis of water or water which includes electrolytes is a well-known technique. And by using this technique, a method of manufacturing healthy drinking water or sterile water is becoming popular. Many methods or equipments are proposed in prior arts, such as Japanese patent publication 4-28239, 4-57394, Japanese Laid-open publication 6-47376, 6-55173 and 6-246268. Construction of an apparatus for producing ionized water is characterized as installing cathode and anode in water or water which includes electrolytes with a distance, separating the ionized water by a diaphragm between the two electrodes.

Usually, to obtain a higher electrolysis efficiency, the distance between cathode and anode is designed to be as short as possible. As an electrolysis reaction occurs at the surface of two electrodes in water or water which includes electrolytes, acid and alkaline ions and gases are generated in two narrow spaces between the electrodes and a diaphragm. To obtain high electrolysis efficiency on the objected water, generated ions must be dispersed smoothly into water or water which includes electrolytes and generated gases must be diffused quickly. Consequently, the construction of apparatus becomes more complicated to satisfy these above mentioned conditions. The object of this invention is to provide an apparatus for electrolysis which improves an electrolysis efficiency by shortening the distance between two electrodes as narrow as possible on accomplishing a smooth dispersion of generated ions and quick diffusion of generated gases, and also to simplify a construction which holds electrodes and diaphragms etc, to be attached to an apparatus for electrolysis.

Thereupon, since a previous apparatus for electrolysis of water has a problem with complicated construction of it, the inventor has conducted intensive studies to reduce the problem, and has accomplished this invention.

According to the present invention there is provided an electrode composition for electrolysis of water, comprising a panel of which one surface is made from electric conductive material and another surface is made from non-electric conductive material, plural holes are bored through said panel, two said panels are arranged so as to hold a diaphragm between the surface of non-electric conductive material of each panel and electrolysis reaction occurs at the outer side of an anode and cathode of said electrode composition.

The invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a perspective view of an example of the composite electrode construction of this invention;
Figure 2 is a cross section taken on line A - A' in Figure 1; and
Figure 3 is a schematic illustration of an electrolysis vessel in which the electrode is arranged.

When voltage is loaded on to a cathode and anode which are placed in water. electrons transfer between surface of electrodes and electrolytic dissociated water or electrolyte. In the case of NaCl is used as an electrolyte, oxygen gas or chlorine gas, is generated on anode side and hydrogen ion and hydronium ion are generated simultaneously in fluid, thus the fluid becomes acidic On cathode side, hydrogen gas and simultaneously hydroxide ion are generated, and so the fluid becomes alkaline. Electrons which transferred from cathode to fluid, migrate in the fluid and come to anode. That is, an electric current flows from anode to cathode.

As reactions which generate ions and gases are taken place closely at the surfaces of cathode and anode. concentration of ions surrounding electrodes become higher. That is, a gradient of ionic concentration is caused. Generally, it is understood that generated substances closely to electrodes such as ions or others are transferred or dispersed by a driving force generated by a gradient of concentration, a gradient of electric potential and by convection of fluid, and a diaphragm stretched between cathode and anode acts to prevent two waters in cathode side and anode side from mixing.

In the case of using a conventional face to face panel shape electrode, electrolysis is actively progressed at the surface of cathode and anode which faced to a diaphragm located between two electrodes, and ion and gas is generated at each electrode. The generated gas becomes tiny bubbles and diffuses from a fluid exists between electrode and diaphragm, and cation and anion are dispersed by effects of gradient of concentration, gradient of electric potential and convection of fluid. Mixing of two fluid can be prevented by diaphragm, however, as there is a gradient of electric potential, ions which exist in the fluid transfer by electrophoresis through a diaphragm to another electrode. This physical phenomenon is put to practical use, for example in a case of production method of NaOH by electrolysis of NaCl. In this case, a generation of NaOH become possible by a transportation of sodium ion from anode side to cathode side by the electrophoresis phenomenon. The object of this invention is to produce an acid ionized water and alkaline ionized water, and to perform this object the generated cation and anion must stay closely to each side so as to make concentration higher. So the transferring of ion to another electrode is not desirable in this invention.

An important point of this invention is that cathode and anode is not arranged as face to face each other but arranged as back to back. As a faced side of each electrode is composed by non-electric conductive materials, and a

diaphragm is arranged between electrodes, an electrolysis reaction is taken place at each outer surface of electrode and generates ions and gases. At this time, as electric current flows through holes bored on each electrodes and through the diaphragm to the outer surface of opposite electrode, a gradient of electric potential only exists in fluid between holes and diaphragm, and does not exist in fluid of outer electrode surface side. Therefore, generated ions disperse far from each electrode by effect of gradient of concentration and by convection, and ions that exist closely to holes bored on electrode partially transfer to the opposite electrode by effect of gradient of electric potential. Thus, generated gases are easily diffused from the fluid far from diaphragm.

At the electrolysis process, electron transfers through fluid between cathode and anode. A distance between electrodes, a diaphragm, and in the case of back to back electrode, holes bored on electrodes mainly causes electric resistance. To improve efficiency of electric power for performing electrolysis, it is desirable to make a distance between electrodes narrower so as to decrease electric resistance. However, in the case of face to face electrode construction, because it is necessary to consider about the transferring of fluid between electrodes and diffusion of gases, there is a limitation of the distance. In the case of back to back electrode construction of this invention, only insulator and a diaphragm are existing between two electrodes, and so it is not necessary to consider about the transferring of fluid and diffusion of gases between two electrodes. Therefore, in this case, a distance between two electrodes is equal to the sum total of thickness of two electrodes, two insulators and a diaphragm.

The surface 1 of the panel is composed by electric conductive materials such as copper, lead, nickel, chrome, titanium, gold, platinum, iron-oxide and graphite. Preferably it is composed by platinum. It is desirable to use a thin plate of metal of 5-100 micron thickness, and more desirably a plate of titanium having 0.1-5 milli meter thickness on which surface platinum is plated. Surface 2 of the panel is composed by non-electric conductive resins, such as polyethylene resin, polypropylene resin. polystyrene resin, polyethyleneterephthalate resin, polyethylenechloride resin, ABS resin acrylic resin, epoxy resin, teflon resin, ceramic, natural rubber, SBR, silicon rubber, chloroprene rubber, fiber reinforced plastic plate and thin film of non-electric conductive paints or synthetic resins. The surfaces 1 and 2 are tightly stuck to each other, and form a panel for cathode and anode.

Holes 3 are bored through the panel so as to be arranged on all active area for electrolysis reaction, and surface area of one hole is from 1 to 500mm^2. The ratio of surface area of holes to that of electrode is 10-90%. and is preferably 30-70%. Material of the diaphragm 4 is generally a non-woven cloth made from asbestos, glass wool. polyvinyl chloride fiber, polyvinylidene chloride fiber. polyester fiber or Kevlar fiber, an unglazed ceramic plate. a sheet of paper and a film of ion-exchange resins. The diaphragm 4 is held between surface 2 of anode and cathode. Anode, cathode and diaphragm can be arranged independently, or diaphragm can be stuck tightly to surface 2 of electrode. And also it is possible to put spacer (not indicated in the drawing) made from non-electric conductive materials to have a possibility of existing fluid between surface 2 and diaphragm 4.

By using the back to back electrode of this invention, because the distance between anode and cathode can be shortened to the sum total of thickness of the electrodes, the insulators and the diaphragm, it is possible to improve the efficiency of electric power for electrolysis. And, since there are not any generations of ion and gas between electrode and diaphragm, it can be ignored that inconsistency of electric current caused by increased electric resistance due to the remainder of gas in fluid or in diaphragm.

Generated ions on the back to back surface electrode of this invention disperse far from electrode by effect of gradient of concentration and by convection, and the transferring power to the opposite electrode by effect of gradient of electric potential is not strong. Therefore, the transferring of generated anion and cation to the opposite electrode is less, and consequently concentration of the object ion can be raised effectively.

In case of a conventional electrolysis method, plates of electrode and a diaphragm must be held independently. However, in the case of this invention, as it is possible to assemble them in simplified construction by sticking a diaphragm tightly or through the medium of spacer to an electrode, a holder to attach the electrode to an electrolysis vessel can be simplified. Therefore, the possibility for modification of electrode design is extended, and it becomes possible to manufacture not only a flat shape electrode but also a modified shape electrode such as having curved surface, spherical surface or angled shape.

This invention is further illustrated in the following examples, however it is to be understood that the invention is not intended to be limited to these examples.

Fig. 1 and Fig. 2 is an illustration of the composite electrode construction 7 which is characterized as simplified by sticking an electrode closely to a diaphragm and arranged in a non-electric conductive frame 6 having contact points 5 for anode and cathode. Fig. 3 is an illustration showing the electrode construction 7 which is arranged in electrolysis chamber 8, and is characterized as to prevent leaking of contained fluid from contact portion of the chamber and the electrode.

Example-1

Water solution which includes 0.03wt% of NaCl is prepared as a testing fluid to be electrolyzed. Two sheets of

titanium plate of lmm thickness on which surface thin layer of platinum is plated, is prepared as the material of the panel and polyethylene film of 0.2mm thickness is spreaded over one surface of said platinum plated titanium plates and forms the panel.

Holes of 5mm diameter are bored in each panels as shown in Figure 1 and 2. The distance between the center of each holes is 7.7mm and the ratio of surface area of holes to whole area is 33%. Said two panels are arranged so as to a polyethylene side is faced, and hold 0.17mm thickness membrene filter (Yumikron MF-60B. Yuasa Co., Ltd. Japan) as a diaphragm between them. The said membrene filter is a polyolefin coated high porous polyester film. Thus the electrode composition of this invention is assembled.

100mm × 100mm size of the electrode composition is placed at the center of one litre capacity electrolysis chamber 8. Said water solution which includes 0.03wt% of NaCl is poured into both separated spaces of the electrolysis chamber formed by the electrode, and mixing and leaking of the water solution can be perfectly prevented by the electrode composition.

Direct current of 13volt constant voltage is loaded, and pH and oxidation-reduction potential are measured according to the progress of time at anode and cathode side by using pH meter and ORP meter. And also the electric current is measured by ammeter. And an electric power efficiency until pH of anode side water becomes 2.7 is calculated. The electric power efficiency obtained by this experiment is 5.1watt·hour/L, and other results are shown in Table. 1.

Example-2

Diameter of holes on the panels is changed to 7mm and the distance between centers of holes is set up to 10mm. In this case, the ratio of surface area of holes to whole area is 44%. Using same electrolysis equipment and same condition, electrolysis experiment is carried on. The obtained results are shown in Table.2.

In this case, the electric power efficiency to obtain pH 2.7 acid ionized water is 3.4watt·hour/L, and it excels to the result obtained in example-1. The effect of wider hole surface area is obvious.

Example-3

0.17mm thickness of membrene filter(Yumicron-60B) is used as a diaphragm, and same panel to example-2 is used to assemble the electrode composition. 360mm × 500mm size of said electrode composition is prepared and placed at the center of 100 litre capacity electrolysis chamber. Same water solution to example-1 is poured into the chamber, and direct current of constant 15ampare is loaded. The obtained results are shown in Table. 3.

This experiment aims an actual application of the invention. And as the good electrical power efficiency is obtained, it seems that this invention has a good possibility of an actual use.

Table.1

time (min)	volt (volt)	currrent (mA)	anode		cathode	
			pH	ORP(mV)	pH	ORP(mV)
0	12.8	245	7.32	+458	7.32	+458
15	13.9	360	2.88	+1025	11.14	-804
30	14.2	320	2.54	+1088	11.57	-862
60	14.5	280	2.32	+1128	11.79	-884
120	14.7	170	2.18	+1173	11.95	-895
Electric power efficiency (pH2.7)					5.1 Watt·Hour/L	

Table.2

time (min)	volt (volt)	currrent (mA)	anode		cathode	
			pH	ORP(mV)	pH	ORP(mV)
0	20.0	500	7.68	+203	7.68	+203
5	20.5	500	2.92	+910	10.58	-773
10	20.5	450	2.66	+894		
20	20.5	500	2.35	+1010	11.44	-867
30	20.6	500	2.20	+1027	11.55	

Table.2 (continued)

time (min)	volt (volt)	currrent (mA)	anode		cathode	
			pH	ORP(mV)	pH	ORP(mV)
40	21.0	500	2.08	+1037	11.58	-874
60	21.0	430	1.99	+1086	11.64	-881
80	21.0	450	1.96	+1099	11.84	
100	21.0	450	1.94	+1108	12.00	-882
120	21.0	450	1.92	+1121	12.01	-880
Electric power efficiency (pH2.7)					3.4 Watt·Hour/L	

Table. 3

time (min)	volt (volt)	currrent (A)	anode		cathode	
			pH	ORP(mV)	pH	ORP(mV)
0	29.3	15.0	7.54	+502	7.54	+502
10	28.5	15.0	4.33	+906		
20	26.5	15.0	2.98	+1052	10.27	-100
30	25.3	15.0	2.66	+1104		
40	24.8	15.0	2.57	+1117		
50	24.1	15.0	2.45	+1130	11.34	-888
60	23.8	15.0	2.38	+1138		
70	23.2	14.8	2.31	+1144		
90	22.8	14.7	2.21	+1151		
100	22.8	14.8	2.18	+1155		
Electric power efficiency (pH2.7)					4.4 Watt·Hour/L	

When water or water which includes electrolytes is ionized to the lower level than pH 2.7, it is almost perfectly sterilized and can be used as germ-free water. And the electric power efficiency to obtain water of lower than pH 2.7 is better than that of a previous electrolysis method which is assumable as around 8-10 watt.hour/L. By using the electrode composition of this invention, germ-free water can be easily and economically obtained, which can be used for mass consumption in a hospital or elsewhere.

While the preferred form of the present invention has been described, it is to be understood that modifications will be apparent to these skilled in the art.

The scope of the invention, therefore, is to be determined solely by the following claims.

Claims

1. A composite electrode (7) for use in the electrolysis of water, the composite electrode comprising:
two panels and a diaphragm (4), each panel comprising a first surface (1) made from an electrically conductive material and a second surface (2) made from a non-electrically conductive material, a plurality of holes (3) being bored through each panel, and the diaphragm (4) being arranged between the second surface (2) of one panel and the second surface (2) of the other panel.

2. A composite electrode according to claim 1, wherein the first surface (1) of at least one panel comprises platinum plated metal.

3. A composite electrode according to claim 1 or 2, wherein the second surface (2) of at least one panel comprises a polyethylene film.

4. A composite electrode according to claim 1, 2 or 3, wherein the area of holes (3) in at least one of said panels (1,2) comprises between 10% and 90% of the total area of said panel.

5. A composite electrode according to claim 4, wherein the area of holes (3) in at least one of said panels (1,2) comprises between 30% and 90% of the total area of said panel, and preferably between 30% and 70%.

6. A method of electrolysing water, comprising arranging the composite electrode (7) according to any preceding claim in an electrolysis chamber (8) to partition the chamber, and passing a direct current between anode and cathode of said composite electrode (7).

7. A method according to claim 6, wherein the composite electrode (7) is arranged approximately in the centre of the electrolysis chamber (8) to divide the chamber into two halves.

Figure. 1

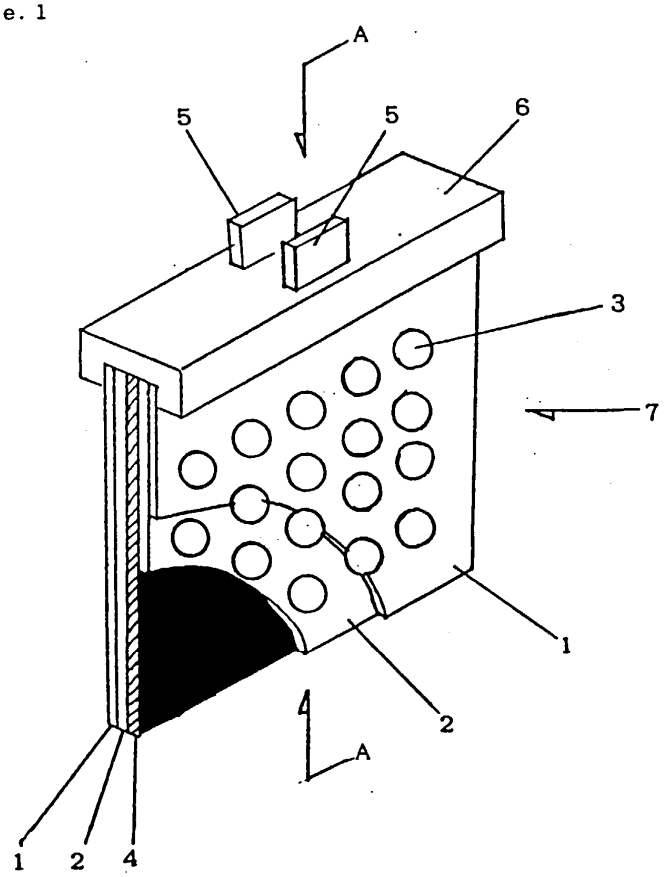


Figure. 2

A-A' cross section

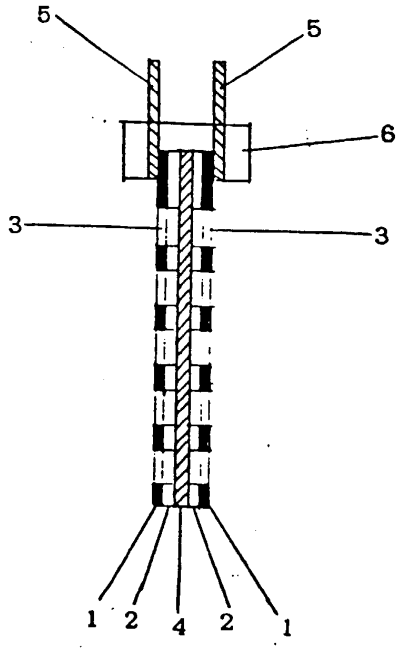
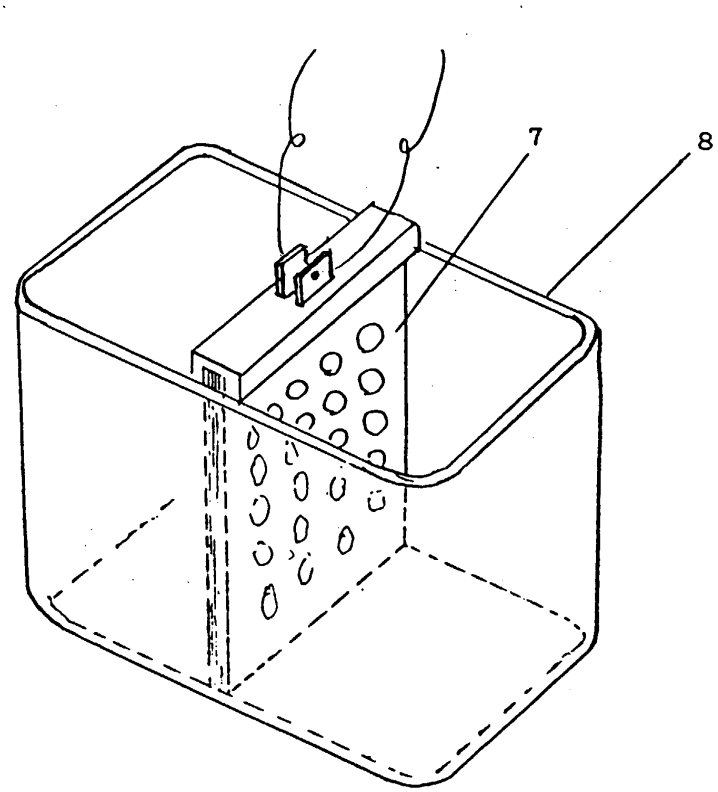


Figure. 3



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(54) APPARATUS AND METHOD FOR REMOVING POLLUTANTS FROM WASTEWATER

(71) We, SWIFT & COMPANY, a Corporation organised and existing under the laws of the State of Delaware, United States of America of 115 West Jackson Boulevard Chicago, State of Illinois, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method and an apparatus for removing pollutants from water, e.g. raw wastewaters and more specifically involves an improved method and apparatus wherein, fine bubbles are provided in flowing water, which bubbles attach to pollutants within the water.

In various fields of industry, processes are practiced in which there are generated raw waste waters containing particles such as suspended oils, fats, protein, fillers, glycerides, fibers, and biodegradable materials, and emulsified fats and oils. Various pollution problems are brought about when such suspended and emulsified particles are permitted to enter natural bodies of water or to enter into sewage treatment systems. In order to lessen such pollution problems, raw wastewaters are processed in a variety of manners.

Prior art techniques indicate that a relative degree of success in purifying such wastewaters can be acieved by passing bubbles of gases such as hydrogen, oxygen or air through a large tank containing industrial wastewater, whereby rising gas bubbles occlude or become attached to some of the particulate matter. The thus treated particles tend to be less dense than water and accordingly, rise to near the surface of the liquid within the tank where they can be skimmed off. Often these processes are combined with chemical treatment. Even then, such prior art techniques are time-consuming and relatively inefficient. Generally, a prior art apparatus cannot economically treat wastewater as quickly as it is generated in a large scale industrial process so as to satisfactorily remove pollutants therefrom.

As described in co-pending Patent Application 1327/75 (Serial No. 1,473,481), improved results can be obtained by first forming a multitude of microbubbles of a gas in wastewater in a quantity in excess of 10^4 microbubbles per liter of liquid to form a buoyant embryo floc of microbubbles and foreign particles, and adding a polyelectrolyte to form a buoyant separable floc that is then separated from the wastewater. It has now been determined that even further improved results — from the point of view of speed, efficiency, energy conservation, size of apparatus, and amount of raw materials utilised — can be obtained with the present method and apparatus hereinafter specifically disclosed and described with reference to the accompanying drawings.

The invention provides a method for removing pollutants from water, which method comprises establishing a zone of fine bubbles in flow of water through a treatment vessel so that the bubbles contact and form aggregates with pollutant in said water, the bubbles being produced by a bubble supply below the zone removing the aggregates and water from the treatment vessel through a conduit to a flotation vessel, allowing the aggregates to rise to the water surface and separating them from the water.

The invention also provides an apparatus for removing pollutants from water which apparatus comprises a closed treatment vessel having an inlet and an outlet at respective ends of a flow path therethrough for water to be treated a bubble supply in said vessel below the flow path of the water for establishing a zone of fine bubbles in the flow path of the water to form pollutant-bubble aggregates in the water, and a flotation vessel connected by a conduit to the outlet from the treatment vessel.

Preferred embodiments of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a schematic illustration of the preferred apparatus;

Figure 2 is an elevation view of the preferred embodiment of a portion of the apparatus of Figure 1;

Figure 3 is a plan view of the embodiment of Figure 2 with parts removed;

Figure 4 is an elevation view of an alternative embodiment of the portion of the apparatus shown in Figures 2 and 3;

Figure 5 is a plan view of the alternative embodiment of Figure 4;

Figure 6 is an elevation view of another alternative embodiment of the portion of the apparatus shown in Figures 2 and 3;

Figure 7 is an elevation view of yet a further alternative embodiment of the portion of the apparatus shown in Figures 2 and 3;

Figure 8 is an elevation view of the preferred flotation vessel, as well as of a further, optional embodiment of the flotation vessel;

Figure 9 is a schematic illustration of the raw wastewater flowing past line 9—9 of Figure 1;

Figure 10 is a schematic illustration of the treated wastewater flowing past line X—X of Figure 1;

Figure 11 is a schematic illustration of the aggregates of bubbles and pollutants or the embryo floc flowing past line XI—XI of Figure 1;

Figure 12 is a schematic illustration of the wastewater and separable floc flowing past line XII—XII of Figure 1; and

Figure 13 is a graphical representation of the relationships between the size and number of the bubbles and a volume percent of the gas bubbles.

In the apparatus of Figure 1 the water which is generally industrial or municipal wastewater, flows through a compact and dense zone of fine bubbles that originate from a bubble supply that is positioned below the zone such that substantially all of the wastewater and of the pollutants therein remain above the bubble supply at all times. Within this zone, the fine bubbles are rapidly contacted with the pollutants to form aggregates of bubbles and pollutants. Thereafter, the aggregates and wastewater flow into a flotation basin and wherein the aggregates rise to the surface of the wastewater and are separated therefrom.

The industrial or municipal raw wastewaters are first pretreated before they enter this zone with one or more coagulants, such as aluminum sulfate, alum, ferric sulfate, ferric chloride and lime, which assist in breaking down emulsions within the wastewater and agglomerating some of the pollutants within the wastewater. This is a preferred step and is not essential to the basic principles of the present invention, since various raw wastewaters will require no additional coagulation, although this step will generally increase, the overall effectiveness of the present process. Figure 1 illustrates this step of adding a coagulant as a pretreatment, and Figure 9 depicts the consistency of a typical raw wastewater flowing into influx conduit 11. Impurities and pollutants are illustrated by a large number of relatively small dots to depict that the raw wastewater can contain approximately 10^8 to 10^9 pollutant particles per liter of wastewater. Figure 10 illustrates the impurities as having a somewhat larger size, after this optional treatment with a coagulant. The approximate pollutant aggregates or particles one minute after coagulant introduction is reduced by roughly a factor of 10, to about 10^7 to 10^8 per liter, due primarily to the fact that such aggregates or particles are combined with each other through the action of the coagulant.

As a further optional step, a compound that will suitably adjust the pH of the raw wastewater can also be added to about the same time that the coagulant is added. Such pH adjusting compounds are exemplified by calcium hydroxide, or any other compound that will result in the pH of the finally clarified wastewater being within the range of 6 to 9, preferably 6 to 8. The purpose of the pH adjuster is to return the pH of the wastewater to levels that meet water discharge requirements of municipalities or other governmental units. The compound may either raise or lower the pH, depending upon the wastewater being treated and any compounds added thereto. For example, most coagulants are acidic, and the addition thereof may require the addition of a compound such as calcium hydroxide to raise the pH.

The wastewater is then treated by flowing same through a tank containing a relatively compact and especially dense zone of very fine bubbles originating from a bubble supply cell below said zone. The bubbles themselves may be produced electrolytically as shown in Figure 1 or may be introduced into the cell from a source of gas bubbles dispersed or dissolved in a fluid. The wastewater flow is generally horizontal and relatively rapid, while the bubbles initially contact the wastewater flow with a substantially vertical orientation due to their rise from said cell to form the dense zone; and when the wastewater flow meets this dense bubble zone within the relatively small volume of the tank, a

moderately turbulent condition is created which increases the amount of direct contact between the bubbles and the pollutants within the wastewater but is not so vigorous as to break up the aggregates of bubbles and pollutants or the embryo floc thus formed. The generally spiral-type upward movement of the wastewater achieved in the embodiment depicted by Figure 2 and 3 is a specific example of the type of moderate turbulent condition that is created within the tank. However, very satisfactory results are also obtained in tanks having general configurations more along the lines of those shown in the various alternatives embodiments, the moderate turbulent condition created in such devices being of a more random nature whereby the bubbles and the flow of wastewater rapidly churn to form the aggregates or the embryo floc.

The wastewater treated after this step is depicted in Figure 11. That Figure is a representation of the aggregates of bubbles and pollutants, which are designated herein as the "embryo floc" when further subsequent flocculation thereof is needed to form a separable floc. As utilized throughout herein, an "embryo floc" is that floc formed by the interaction among coagulant (if used), solid and liquid colloidal pollutants, and fine bubbles, which formation occurs primarily within the tank. An embryo floc while preferably including a coagulant, need not of necessity include same, depending upon the particular wastewater being treated. The embryo floc generally consists of roughly 10^5 to 10^6 aggregates of bubbles and pollutants per liter of treated wastewater. The term "aggregates of bubbles and pollutants" is used herein as generic to both such embryo floc and the separable floc and can be thought of as an embryo floc that is not subsequently treated with a flocculant.

This step whereby the aggregates or the embryo floc is formed is accomplished over a period of from about six seconds to about two minutes, preferably one minute or less, during which time impurities from the wastewater become attached to one or more of the very fine bubbles. This formation of the embryo floc is accomplished very rapidly. The wastewater flows through the system at rate of about N liters per minute and the volume of the tank is preferably within the range of about 1/10 N to 2 N liters; thus, the wastewater remains within the tank and hence is direct contact with the zone of very fine bubbles for from approximately 1/10 minute to 2 minutes. Although this is a very short period of time, an exceptionally large number of aggregates of bubbles and pollutants are nevertheless formed to develop a superior embryo floc due to the exceptionally high quantity of bubbles (10^4 to 10^{10} bubbles per liter of wastewater preferably 10^6 to 10^9 bubbles per liter, small bubbles size (10 to 500 microns, preferably 20 to 300 microns, in diameter), and the moderate turbulence created within the tank.

In order to illustrate some relationships of various parameters of bubbles produced in accordance with the present invention, Figure 13 plots experimental data accumulated for one particular type of wastewater which was treated by electrolytically produced bubbles in a test tube environment approximating that of the preferred apparatus and method. Such wastewater was a tannery wastewater having approximately 1,300 mg/l BOD (biochemical oxygen demand) and 456 mg/l hexane extractables. From Figure 13, it can be seen that satisfactory-to-excellent results can be obtained for this tannery wastewater if from 0.5 to 50 ampere minutes per gallon of wastewater are supplied by the electrodes. From an economic viewpoint, greater than 10 ampere minutes per gallon tends to be unnecessary. The preferred range has been found to be 1.5 to 8 ampere minutes per gallon of tannery wastewater.

When currents within these ranges are supplied, there are produced in the tannery wastewater volume percents of electrolytically produced gas bubbles in the bubble supply cell of from 0.1 percent to 10 percent. Excellent results are found to be obtained if from 0.3 to 10 volume percent of electrolytic gases are present. A most economic range has been found to be 0.3 to 2 volume percent.

The relationship between the volume percent of gases within the bubble supply cell and the actual number of bubbles per liter produced within the cell depends, of course, upon the size of the bubbles. For example, excellent results can still be obtained with an average bubble diameter of about 300 microns, there being produced 10^6 bubbles per liter. However, in order to achieve these excellent results, the relatively high amount of ampere minutes per gallon, and hence relatively high volume percent of gases, are required when the average bubble diameter is this large. But, as can be seen from Figure 13, when the average bubble diameter is decreased to 30 microns, substantially more bubbles are produced with a flow of the same current and indeed excellent results can still be achieved with a current flow significantly less than is needed when bubbles generated are of a much larger diameter.

It is to be noted that all of the bubble and

current parameters depicted on Figure 13 are well within the scope of the present invention when it is utilized with this particular tannery wastewater. Specific bubble and current parameters will vary with different wastewaters. Figure 13 does illustrate the general proposition that significant advantages are obtained when bubble sizes are reduced.

In an optical step of the present method, the bubble size is kept especially small and of particularly consistent size. This step is essentially the flowing of a surfactant into the bubble supply cell, preferably near the bottom thereof, which results in the formation of bubbles that are kept consistently within the range of 10 to 100 microns in diameter and generally kept within the very narrow range and exceptionally small diameter size of 30 to 50 microns. Generally, excellent results are achieved since the smaller and more numerous bubbles are more easily captured by the wastewater pollutants. One reason for this effect is that the rate at which bubbles rise in a liquid is a function of their size, with smaller bubbles rising more slowly. The slower the bubbles rise, the longer they remain in the tank, thereby increasing the chance that they will contact a wastewater particle, so as to increase the speed and improve the efficiency of formation of the aggregates of bubbles and pollutants or the embryo floc as is generally depicted in Figure 11.

Almost any surfactant may be utilized in this optional step including those of the non-ionic, anionic, or cationic variety, such as nonylphenylpolyethylene glycol ether (non-ionic), alkylphenyloxidepolyethanol (non-ionic) (i.e. a polyethyoxylated alkyl phenol) sodium alkyl aryl sulfonate (anionic), dodecylbenzene ammonium chloride (cationic), tetradecylbenzene ammonium chloride (cationic), hexadecylbenzene ammonium chloride (cationic), or alkyldimethyl amineoxide (cationic).

The amount of surfactant added to the bubble supply cell is preferably maintained within the range of 0.0001 to 0.1 percent by weight of the aqueous phase within the cell. By this step, it has been determined that the surface tension of the aqueous phase within the cell is reduced to values between 20 to 40 dynes per square centimeter. This low surface tension significantly assists in the generation of bubbles consistently kept within the range of 10 to 100 microns, preferably 30 to 50 microns, as an average diameter. If a surfactant is not present, the surface tension is of the order of 72 dynes per square centimeter.

The optional surfactant addition step has particular significance in that same is not added to a large volume of wastewater. Having to add the surfactant to a large volume would be very costly, would itself add a further pollutant, and would make more difficult the ultimate removal of pollutants. Instead of adding surfactant to a large tank of wastewater, for example, such as to the flotation basin of the present apparatus, surfactant in accordance with this optional step need be supplied for distribution only within the relatively small volume of the bubble supply cell.

Another optional step of the present method may be included when the bubbles are produced electrolytically. It consists of the introduction of an aqueous source of ionic species into the cell, preferably near the bottom thereof. This generally has the effect of aiding in the current generated between the electrodes. In other words, it increases the ampere minutes per gallon that can be generated by the electrodes within the cell without varying the voltage. This aqueous source of ionic species includes water, which may contain acids, bases, or salts. This step is especially useful in processing industrial wastewaters that have relatively low electrolytic conductivity. If these ionic species include ions such as chloride ions, the additional feature of providing a disinfecting agent is achieved when such chloride ions liberate chlorine. Exemplary of suitable ionic species are compounds such as sodium chloride, sulfuric acid, sodium bromide, sodium iodide, sodium sulfate, ferric sulfate, alum, and calcium hydroxide. The concentration of such ionic species (anions and cations) within the bubble supply cell should be kept within a range of 0.005 Normal to 0.05 Normal.

As a further optional step between the essential step of forming aggregates (by rapidly contacting a flowing wastewater with a dense zone of bubbles introduced below the wastewater flow) and the essential step of flowing to a flotation basin, a flocculant is added to the flow. A flocculant such as a polyelectrolyte is added to the embryo floc in concentrations of 1/2 to 15 ppm, preferably 1/2 to 6 ppm, thereby assisting in the formation of the separable floc. Figure 12 depicts this separable floc, which is in essence the embryo floc treated with a flocculant. Such separable floc includes conglomerates of impurities, the coagulant (if any), the flocculant, and a relatively large number of fine bubbles. The separable floc has a relatively compact structure and has a low apparent density (usually within the approximate range of 0.7 to 0.9) and thus has substantial buoyancy in water.

This optional step whereby flocculant is

added can be omitted when a particularly well developed embryo floc, designated herein as aggregates of bubbles and pollutants, is formed in a particular wastewater. If such is the case, there is no need to form a separable floc since such aggregates exhibit substantially the same physical attributes as does the separable floc. This step is accomplished by flocculant being added to the flow of the embryo floc, thereby achieving a mild mixing and a formation of the separable floc. While the present process is not restricted to the use of a particular flocculant, it has been found that polyelectrolytes produce outstanding results. Such include polyacrylic acrylamides, copolymers of from 50 to 90 weight percent acrylamides or methacrylamides, and from 10 to 50 weight percent acrylic or methacrylic acid or water-soluble salts thereof. These polymers are characterized by weight average molecular weight or 2 million and usually within the range of 7 to 12 million as measured by light scattering techniques. Such polymers are known in the art and are available from several commercial sources.

Proceeding with a detailed discussion of the next essential step of the present method, the separable floc or the aggregates of bubbles and pollutants, along with the aqueous phase of the wastewater that has now been substantially clarified, flow into a large enclosed area such as a flotation basin. Since the density of the separable floc or of the aggregates is significantly less than that of water, the full floc or the aggregates quickly rise to the surface of the clarified water within the flotation basin. The separable floc or aggregates are then simply allowed to float to near the top surface of the contents of the flotation basin, whereupon such top surface is skimmed off and kept separated from the clarified water which itself flows from the basin through an efflux conduit. Preferably, the efflux of the clarified water is accomplished toward the bottom of the basin. It is preferred that the skimming off be in a direction substantially opposite to that of the general direction of the flow of the clarified water, so as to reduce the chance of any of the separable floc or aggregates flowing through the efflux means for the clarified water.

As, a further, optional step of the present method which may be utilized in addition to the essential separating step previously described, gas bubbles, such as those of air, hydrogen, or oxygen, may be introduced into the flotation basin near its bottom and permitted to bubble therethrough in order to assist in the rising of the separable floc or the aggregates. Such additional step is not an essential method step. As a further refinement, the quantity of bubbles introduced can be greatest at that portion of the basin where the treated wastewater enters the basin, said bubble quantity becoming gradually less and less downstream of such point of entry.

As a further additional optional step, some of the clarified water flowing through the effflux conduit within the flotation basin may be directed to the bubble supply cell for the purpose of replenishing the water supply needed to continue the supplying of gas bubbles there within.

In the preferred embodiment of the apparatus illustrated in Figure 1, an industrial or municipal raw wastewater flows into the apparatus through influx conduit 11. The dimensions of the conduit 11 are such as to accommodate a flow of N liters per minute of raw wastewater. Along conduit 11 may be provided optional coagulant injector 12 and/or optional further injector 13 for adding a compound to adjust the pH of the wastewater. If desired, either or both of the injectors 12 and 13 can be omitted. As previously discussed, whether or not it would be helpful to add a coagulant or a compound to adjust pH would depend upon the particular impurities that are present within the raw wastewater that is being treated. Such injectors 12 and 13, when included, contain fluid moving devices, such as metering pumps capable of introducing a predetermined quantity of fluid into the present apparatus and also including a conduit member that connects the injector to the desired location within the apparatus.

Downstream of any such introducer 12 or 13 is a tank 14. Tank 14 may be of any size and shape, for example, having circular, square, or rectangular cross-sections. As previously mentioned, tank 14 has a volume 1/10 N to 2 N liters, preferably N liters, to assist in achieving the desired rapid aggregate formation.

Located immediately below the tank member 14 is a cell 15. More than one such cell 15 may be provided, if desired. The top surface of the cell 15 is in communication with at least a portion of the bottom surface of tank 14. Located within the cell 15 is a bubble introduction means 20.

Bubble introduction means 20 is provided for supplying hydrogen, oxygen, or other gas bubbles within cell 15. The bubble introduction means 20 preferably includes electrodes, described in more detail hereinafter in connection with Figures 2, 3, 4 and 5 which are constructed of a conductive material such as a metal are substantially parallel to each other and are spaced apart at a distance of from 1/16th

inch to 2 inches and are connected to a power source. When current flows between the electrodes, water within cell 15 is decomposed into hydrogen and oxygen gas bubbles. Although such an electrode arrangement is preferred, the bubble introduction means 20 may instead supply air bubbles or other gas bubbles, which bubbles are either dissolved in water (Figure 6) by a means for pumping gas under pressure into water or are dispersed in water (Figure 7) by a blender or a mixer, as hereinafter described.

An aqueous fluid injector 16 is not an essential feature of the present apparatus. When provided, it is in direct communication with the cell 15. The injector 16 can be utilized to introduce aqueous fluids into cell 15 e.g. tap water, water containing ionic species, or an aqueous system including a surfactant. The aqueous fluid injector 16, when provided, has a structure along the lines of injector 12 or 13, as hereinbefore described. If injector 16 is omitted the aqueous fluid otherwise provided thereby is supplied from the wastewater itself, entering from the top of cell 15 through tank 14.

In communication with the top surface of the tank 14 is a gas escape tube 17, which may be included to vent gases or to relieve excessive gas pressure within the tank 14 by providing a conduit through which gases which have not been combined with particles in the tank 14 may escape.

Flocculant injector 18, when provided, is downstream of the tank 14 and in communication with a transfer conduit 10, which conduit permits treated wastewater to flow between the tank 14 and flotation basin 19, downstream therefrom. In the preferred embodiment, flotation basin 19 is rectangular in cross-section and includes a skimming means 22 well above substantially parallel with the bottom surface of the basin 19. The flotation basin includes an efflux conduit 23 through which the water clarified by the present apparatus flows. Also provided is skimmings efflux conduit 24 through which the pollutants are moved for storage, safe disposal, or further treatment.

While many specific structural details can be varied within the scope of the present apparatus, a preferred embodiment of the cell 15 and tank 14 is shown in Figures 2 and 3. In this preferred embodiment, the bubble introduction means 20 includes a plurality of electrodes 21 that are positioned within cell 15. In Figure 2, they are shown as being suspended within the tank 15 by a hanger member 38. Hanger member 38 must provide for the insulation of electrodes 21 from each other. An inexpensive and convenient material out of which member 38 may be constructed is wood. However, almost any other type of material is suitable, provided the electrodes are insulated from each other along member 38.

Each alternate electrode is connected to the power source by means of connecting member 31, which can take the form of one or more electrical wires. Each of the remaining alternate electrodes 21 are connected to another electrode connecting member 31′ of similar construction, which is also connected to the power source.

Preferably, provision is made for polarity reversal so that the electrodes serving as cathodes can, when desired, be utilized as anodes, and vice versa. Polarity reversal can be accomplished manually by reversing the connections between connecting member 31 and connecting member 31′ to the terminals of a DC power source or a rectified AC power source. This same result can be accomplished instead, for example, by utilizing a device such as a reversing switch (not shown).

In Figure 2, the electrodes 21 themselves are shown as hanging in a vertical direction. However, it is well within the scope of the present invention that such electrodes may be securely fastened such that they lie substantially horizontally (Figures 4 and 5). This latter alternative can even be more advantageous than the arrangement shown in Figure 2, since the bubbles which are generated along the full length of the electrodes are less likely to come into contact with each other within the cell 15 when the electrodes are positioned in a horizontal orientation rather than a vertical orientation, with the result that the bubbles reach the tank 14 in a manner that has improved efficiency. The vertical orientation has the practical advantage of permitting a relatively simple and inexpensive means for suspending electrodes 21, particularly when the electrodes are made of a material that has only average conductivity and is relatively heavy, as is the case for Duriron electrodes which may be utilized in this embodiment.

It has been found that, in order to achieve an amperage adequate to supply bubbles of the proper size and density, if electrodes made of Duriron are utilized, a large number of relatively large electrodes must be provided. For example, in the preferred embodiment of this apparatus, there are provided about 70 electrodes that are spaced apart at a distance of from 1/2 to 2 inches rod-shaped, and made of Duriron having a diameter of from 1.5 inches to 2 inches and a length of 5 feet. Of course, the particular dimensions of the Duriron electrodes will vary depending upon the

number of electrodes, the total current to be generated, the spacing between the electrodes, the voltage, and the conductivity of the water.

The preferred embodiment also includes a fluid distribution conduit 41. This conduit can provide a variety of functions. It can be utilized to flush out impurities that may have inadvertently entered the cell 15. It may also be utilized as a means to introduce a variety of fluids into the cell 15, preferably near the bottom thereof. For example, tap water can be introduced therethrough by means of the aqueous fluid injector 16, which tap water can be provided for the purpose of being decomposed at electrodes 21. Together with or in place of supplying tap water, conduit 41 can be utilized to introduce ionic species into the cell 15 for the purpose of improving the conductivity of the system and hence increasing the efficiency of the decomposition process. A surfactant also muy be introduced into the cell 15 through the conduit 41. If conduit 41 is not provided, the water that is decomposed by the electrodes 21 may be replenished from the flow of wastewater itself.

The entire top surface of the preferred cell 15 is in direct communication with the bottom surface of the tank 14. Cell 15 is secured to tank 14 by means of bolts 44 located through holes 45 in a flange 46 along the top periphery of cell 15, bolts 44 also passing through holes 47 in tank 14.

The tank 14 itself may be of any convenient shape. The preferred embodiment utilizes a tank 14 that is a right cylinder, the horizontal cross-section thereof being the circular cross-section of the right cylinder. This arrangement can be best seen in Figure 3. While this particular construction is by no means essential to the present invention, it has been found that the wastewater tends to flow around the circumference of a tank 14 having this particular construction, with the flow of bubbles from the cell 15 urging this wastewater flowing along such circumference to flow upward in a moderately turbulent, spiral type fashion. This effect, while not essentially to the present invention, appears to aid in the preventing of large particulate matter from entering the cell 15 and also serves to provide a relatively long wastewater flow path within the tank 14, to thereby increase the probability that pollutants will come into contact with bubbles within the tank 14. A further feature of the preferred apparatus is the fact that the influx conduit 11 is positioned near the bottom surface of the tank 14 and the transfer conduit 10 is positioned near the top surface of tank 14. This arrangement assists in the formation of the upward spiral-type effect.

It is to be emphasized that adequate results are still obtained with tank 14 and cell 15 configurations different from those of the preferred embodiment described above. For example, as depicted in Figure 1, the cell 15 may be of a right cylindrical configuration and the tank 14 may be of a rectangular box-shaped configuration with influx conduit 11 and transfer conduit 10 being positioned at approximately the same height along substantially opposite sides of the tank 14. Such an arrangement is suitable for producing the rapid mixing of bubbles and wastewater to achieve a type of churning action moderate turbulence.

The electrodes, when positioned vertically can be arranged in any convenient fashion, for example, by concentric circles or by rows of electrodes as depicted in Figure 3. It is only essential that the arrangement be such as to provide enough free space within the cell so that the bubbles will readily pass up through the cell 15 and into the tank 14.

Figures 4 and 5 show an alternate embodiment of the bubble introduction means 20. A plurality of electrodes 121 are positioned within cell 115 in a substantially horizontal manner. They are in alternate communication with either of two electrode connecting members 131 and 131′ so as to form two fork-shaped electrode units oriented in opposite directions, with electrodes from one fork-shaped electrode unit alternating with and being spaced between and substantially parallel to the electrode from the other fork-shaped electrode unit, the preferred spacing of adjacent electrodes being from 1/16 to 1 inch. Each connecting member 131, 131′ is attached to a terminal member 132, 132′ which extends outside of the cell 115 for ultimate connection to the power source by cables.

As can be best seen in Figure 4, the particular construction shown for this alternate embodiment is such as to permit easy removal of the electrodes to facilitate replacement or repair thereof, while maintaining the water-tight integrity of the cell 115. This particular construction is intended as only one manner by which the electrodes may be removed. The particular structure illustrated includes a threaded fastening means 133 having a bolt member 134, the fastening means 133 securing one of the terminal members 132′ onto the cell 115. The other terminal member 132 is secured to the cell 115 by a threaded fastening means 135 having a bolt and bracket assembly 136. To remove the electrodes, threaded fastening means 136 and bolt member 134 are loosened, as is

threaded fastening member 135. Bolt and bracket means 136 is removed and the entire electrode unit, including both of the two fork-shaped electrode units and terminal members 132, 132', is slid through opening 137 which is closed by bolt and bracket assembly 136 when the cell 115 is in operation.

This alternative embodiment preferably includes a fluid distribution conduit 141 positioned below the electrodes 121 within the cell 115. This conduit 141 is in communication with the aqueous fluid injector 16, (Figure 1) for the purpose of introducing into the cell 115 any one or more of the aqueous fluids previously mentioned. Which of these, if any, are to be utilized will depend upon the materials already in the wastewater being treated. For example, an ionic species is added only if the particular electrode surface area, material, and spacing between electrodes are not adequate to generate the desired amount of current with the water within the cell 115. Similarly, a surfactant is added only if the particular electrode configuration and the water within the cell do not produce bubbles of the proper size. If surfactant is added into the cell of the present apparatus, it generally is economically feasible to do so, since the size of the cell into which the surfactant is to be added is a relatively small volume when compared with, for example, the volume of the flotation basin 19. While this feature applies for all embodiments, it is especially applicable to the alternate embodiment of Figures 4 and 5, since cell 115 usually contains highly conductive, closely spaced, and relatively small electrodes 121, which permits the cell 115 to be smaller in size than is generally possible with the other embodiments.

When desired, the aqueous liquids introduced into cell 115 through fluid distribution conduit 141 may be supplied by separate means and pumped into the cell by the aqueous fluid injector 16. An alternate feature of this invention is that such aqueous fluid or one of the aqueous fluids, if more than one is required, may actually be the clarified wastewater that flows from the efflux conduit 23. In communication with efflux conduit 23 can be a conduit 25 (Figure 1) which can either be in direct communication with conduit 141 or can be introduced thereinto after passing through injector 16. Utilising this arrangement, the clarified water provides all or part of the supply of water to be decomposed within the cell 115. This is a convenient arrangement, particularly if the clarified wastewater has qualities that are particularly advantageous for use within the specific cell 115.

It is also within the scope of this embodiment that the water to be decomposed by the electrodes 121 is replenished by wastewater flowing into the cell 115 through tank 114. However, when conduit 141 is provided, the fluid enters the cell 115 through one or more openings 142, which may be either a plurality of orifices or an elongated slot. In either event, each opening 142 is preferably directed at angles so as to provide relatively uniform distribution of the aqueous fluid below the electrodes 121. For example, effective distribution is found to occur if angle A (Figure 4) is 75°.

A further optional feature of this embodiment is flushing conduit 143, which is provided to facilitate cleaning of the tank 114 and the cell 115, whereby any waste products or pollutants they may have accumulated therewithin may be flushed out through said flushing conduit 143.

Generally, the entire top surface of the cell 115 is in communication with the tank 114. Cell 115 and tank 114 are secured to each other by fastening members such as bolts 144 which pass through holes 145 in flange 146 along the upper periphery of the cell 115, the bolts 144 also passing through holes 147 in tank 114. This arrangement is such as to provide a watertight seal between tank 114 and cell 115.

As can be best seen in Figure 5, the electrodes 121 of this alternate embodiment are parallel to each other and alternate electrodes are joined to one of the two electrode connecting members 131 or 131'. When each terminal member 132, 132' is connected to the power source the electrodes in contact with one of the connecting members serve as cathodes, while remaining electrodes serve as anodes. Preferably, provision is made for polarity reversal so that the electrodes serving as cathodes can, when desired, be utilized as anodes, and vice versa. As with the preferred embodiment, polarity reversal can be accomplished either manually or through a device such as a reversing switch.

While the preferred embodiment of the cell and tank shown in Figures 2 and 3 is particularly well-suited for use with electrodes made of Duriron, both electrodes 21 of that embodiment and electrodes 121 of this alternate embodiment may be made of either partially soluble variety, such as those made from ferrosilicon alloys, including Duriron, or may be of the insoluble type and made from materials such as palladium-coated titanium, platinized titanium, platinized niobium, platinized tantalum, carbon, graphite, aluminum, platinum, lead-antimony-silver alloys or ruthenium oxide coated metals. Preferred for utilization in

this alternate embodiment as the electrodes 121 are those that display particularly high conductivity and that are of the insoluble type.

Generally, the electrodes of this embodiment are arranged so as to generate particularly high current densities (within the range of about 80 to 150 amps per square foot) at low voltages (on the order of about 10 to 15 volts). Such is accomplished by providing electrodes that are rectangular in cross-section, are relatively thin, are oriented such that the width thereof is substantially vertical, and are closely spaced with respect to each other. More particularly, the electrodes 121 have a thickness dimension "T" of from 1/8 to 1/4 inch (approximately 0.317 to 0.635 cm.), a width or vertical dimension "W" of 1/2 inch (about 1.27 cm) up to five inches, and any convenient length, depending upon the size of the cell 115, a generally suitable length being two feet (approximately 66 cm.) up to five feet.

Theoretically, the electrodes 121 should be as close together as possible to accomplish the especially high densities featured by this embodiment. Spacings of less than one inch are generally required. Optimum spacing has been found to be within the range of 1/16 to 1/4 inch (approximately 0.159 to 0.639 cm.). Spacings smaller than 1/16 inch have the disadvantage of clogging too easily. An especially suitable distance has been found to be 3/16 inch (approximately 0.47 cm.). This spacing, while it is exceptionally close for this art is made practicable primarily due to the following.

In the present apparatus, the industrial wastewater flows through tank 114; that is, it flows above and not through the cell 115. Also in the preferred structure of this alternate embodiment, a separate supply of water for decomposition into the gas bubbles enters cell 115 from below the electrodes 121 through the conduit 141. Consequently, substantially all of the impurities within the wastewater remain above the cell 115 and electrodes 121 therein, thereby eliminating any appreciable flow of impurities through the electrodes 121 themselves, between which impurities would otherwise be trapped.

Figures 6 and 7 relate to two further alternate embodiments of the bubble introduction means 20, neither of which utilizes means to supply the bubbles by electrolytic decomposition of water as do the preferred embodiment and the alternate embodiment of Figures 4 and 5. Instead, gas bubbles are supplied within a water source introduced into the cell 215. Similar to the preferred embodiment and the other alternate embodiment previously described it is essential that such gas bubbles, which may be air or another gas, rise within cell 215 and enter tank 214 from below the stream of water flowing through tank 214 which is in watertight communication with the top portion of cell 215. As with the other embodiments, such gas bubbles for aggregates of bubbles and pollutants, said pollutants having been within the stream of wastewater entering said tank 214 through influx conduit 211, and said aggregates and wastewater flow out of tank 214 through transfer conduit 210. As with the other embodiments, a gas escape tube 217 is provided in tank 214.

Referring particularly to the alternate embodiment of Figure 6, a supply of gas dissolved in water is provided which is introduced into cell 215 by means of a plurality of connected conduits 261 positioned within the cell 215, each conduit having a plurality of orifices 262 to permit the dissolved gas bubbles to rise within cell 215 and to form the dense zone of fine bubbles. The supply of gas dissolved in water is prepared within compression means 263, which is generally a cylinder having a rod 264 and a piston 265 slidably positioned therein. Aqueous fluid is supplied into compression means 263 by aqueous fluid injector 216. As with the aqueous fluid injector 16 of the other embodiments, injector 216 may have either its own separate source of fluid (not shown) or be in communication with conduit 25 (Figure 1) and thereby be fed with water clarified in the present apparatus. In communication with compression means 263 is a gas inlet member 266, which may be either simply open to atmosphere or may be in communication with a gas supply means (not shown). When rod 264 and hence piston 265 are drawn back within compression means 263, aqueous fluid and gas enter therein and are compressed upon the return stroke of piston 265 to thereby dissolve gas bubbles within the aqueous fluid. The dissolved bubbles in the fluid pass into cell 215 by means of fluid distribution conduit 241. Surfactant may also be introduced through conduit 241, if desired. A means for flushing out impurities accumulated within cell 215 is provided by flushing conduit 243.

The other alternate embodiment, represented by Figure 7, is similar to that of Figure 6, also including a plurality of connected conduits 261 with orifices 262. This embodiment, however, includes a blending means 273 for dispersing gas bubbles in aqueous fluid instead of the compression means 263 for dissolving gas bubbles in aqueous fluid. The blending means 273 has a plurality of mixing blades 275 mounted along a shaft member 274

which is rotatably mounted within blending means 273. Shaft member 274 is connected to motor means 277 for rotating the mixing blades 275. Water is supplied into blending means 273 by injector 216. As is the case for the other embodiments, injector 216 may have its own supply of aqueous fluid (not shown) or may be fed through conduit 25 (Figure 1) with water clarified by the present apparatus. The blending means 273 is supplied with a gas through gas inlet member 276, which may be open to the atmosphere or in communication with a supply of gas (not shown). Through the rotation of the mixing blades 275, gases entering the blending means 273 through inlet member 276 are dispersed throughout the aqueous fluid, after which the aqueous fluid with gas dispersed therein passes through fluid distribution conduit 241 and into cell 215. Such dispersed air supplies the bubbles necessary to form the dense zone of bubbles within tank 214.

Figure 8 shows in more detail the structure of the flotation basin 19 in accordance with the preferred embodiment of the present apparatus. The previously treated wastewater flows into the basin 19 through transfer conduit 10. The flow thereof is directed generally upwardly within the flotation basin 19 by vertical baffle member 51. The wastewater flow is further directed in a downstream direction by triangular baffle member 52. The aggregates of bubbles and pollutants or the separable floc within the treated wastewater rises to the surface of the wastewater within the basin 19, whereupon it comes into contact with skimming means 22. Skimming means 22 preferably consists of a conveyor means 53 having a plurality of skimming elements 54. The conveyor menas 53 travels around a plurality of roller members 55 such that the undersurface thereof travels through basin 19 in a direction opposite to that of the general flow of the wastewater within the basin. Skimming elements 54 then come into contact with the aggregates or the separable floc at the top surface and direct it out of the basin 19 and through skimmings efflux conduit 24. Clarified wastewater flows under the baffle at the downstream end of the tank to the outlet 23. The baffle ensures that water is withdrawn from the lower part of the flotation vessel.

An optional, additional feature of flotation basin 19 is also shown in Figure 8. Generally, this optional feature is any means that will provide a supply of bubbles originating from near the bottom surface of the flotation basin 19. It is emphasized that this optional structure is provided merely to assist in the flotation of the separable floc or aggregates within basin 19 so that they may be more readily skimmed off. It is not provided for the purpose of forming the separable floc or aggregates. In the particular structure shown in Figure 8, a plurality of rod-shaped Duriron electrodes 56 are provided within flotation basin 19. As depicted in Figure 8, these electrodes are provided in anode-cathode pairs, the polarity of which may be periodically reversed. Again in accordance with the particular structure that is shown in Figure 8, these electrode pairs are spaced unevenly from each other. This arrangement permits the generation of a greater quantity of bubbles at locations where the aggregates or the separable floc is thickest, which is along that portion of the basin 19 where the treated wastewater enters.

The following examples are set forth as illustrative embodiments of the method and are not to be taken in any manner as limiting the scope of the invention which is defined by the appended claims.

EXAMPLE I

An industrial installation at a beef slaughtering plant processed wastewater at a rate of 2,270 liters per minute. First added was 350 mg/liter of ferric sulfate as a coagulant. Thereafter, 60 mg/liter of calcium hydroxide was added to adjust the pH. Then, the wastewater was allowed to enter a tank in accordance with the preferred apparatus as described herein. In this particular apparatus, the cell contained electrodes made from a ferrosilicon alloy (Duriron), there being 70 rod electrodes having a circular cross-section of either 1.5 inches or 2 inches in diameter and a length of about 5 feet. The electrodes were suspended within a cell having a square cross-section by means of wooden hangers positioned near the top of the electrodes. The conductivity generated in this example was about 700 micromhos per centimeter and 500 amperes of current flowed when applied by a 12 volt DC power source. Satisfactory results were obtained. It was observed that even better results were obtained and the current flow was substantially increased to about 1500 amperes, while still utilizing a 12 volt source, by introducing approximately 1.9 liters per minute of 20 weight percent sulfuric acid as an ionic species introduced below the electrodes. Characteristics of the raw wastewater were 1213 mg/liter BOD (biochemical oxygen demand), 350 mg/liter total suspended solids and 610 mg/liter hexane extractables, while those of the treated wastewater were 95 mg/liter BOD, 86 mg/liter total suspended solids, and 16 mg/liter hexane extractables.

EXAMPLE II

To approximately 100 cc of tannery wastewater having approximately 1,300 mg/liter BOD and 456 mg/liter hexane extractables were added 1,200 mg/liter of ferric sulfate, followed by 600 mg/liter calcium hydroxide. Electrodes in the cell were rod-shaped, having a diameter of 1/8 inch and constructed of platinized titanium, with the spacing therebetween being about 1/4 inch. Upon the application of 12 volts, 144 amperes per square foot of electrode surface were generated. This current was permitted to flow for 16 seconds, after which time essentially 100 percent of the impurities were combined with bubbles generated by water decomposition within the cell to form an embryo floc. Then, 2 mg/liter of polyelectrolyte was added, accompanied by mild agitation, to form a separable floc which rapidly rose to the surface, with the aqueous phase being substantially completely clarified, the treated wastewater having an analysis on the order of that of Example I.

EXAMPLE III

Example II was essentially repeated except that this time a surfactant was added after the calcium hydroxide was added. It was found that essentially the same results were achieved as in Example II, except that this time the virtually complete clarification was obtained after the current flowed for only 10 seconds. This example illustrates the increased efficiency obtainable by the use of a surfactant in the present apparatus, the energy requirements having been reduced by roughly 30 percent.

EXAMPLE IV

This example was carried out in the apparatus of the present invention, using the alternative electrode embodiment of Figures 4 and 5. The electrodes were of platinized titanium, spaced 3/16 inch (about 0.47 cm.) apart, and each had a surface area of 5 square feet (about 0.5 sq. meter). A flow of 260 gallons per minute (approximately 945 liters per minute) of meat processing wastewater was treated with 300 mg/liter ferric sulfate. A current of 600 amperes in toto was generated by a 12 volt DC power source. Fed into the apparatus below the electrodes was a surfactant pumped in at a rate of 5 gallons per minute (approximately 19 liters per minute). The surfactant was non-ionic, a solution of nonylphenylpolyethyylene glycol ether having a concentration of 0.1 weight percent. The untreated wastewater was analyzed as 1,600 mg/liter BOD (biochemical oxygen demand); 600 mg/liter SS (total suspended solids); and 850 mg/liter hexane extractables. After clarification by the present apparatus and method, the analysis was 110 mg/liter BOD 30 mg/liter SS; and 20 mg/liter hexane extractables.

WHAT WE CLAIM IS:—

1. A method for removing pollutants from water, which method comprises establishing a zone of fine bubbles in flow of water through a treatment vessel so that the bubbles contact and form aggregates with pollutant in said water, the bubbles being produced by a bubble supply below the zone, removing the aggregates and water from the treatment vessel through a conduit to a flotation vessel, allowing the aggregates to rise to the water surface and separating them from the water.

2. A method as claimed in Claim 1, wherein the initial direction of flow of the water through the zone of bubbles is substantially horizontal and the bubbles enter the zone from the bubble supply in a substantially vertical direction in such a manner as to develop turbulence in the zone of bubbles.

3. A method as claimed in Claim 1 or Claim 2, wherein the bubbles are produced in the presence of a surfactant.

4. A method as claimed in any one of Claims 1 to 3, wherein the bubbles are produced by the electrolytic decomposition of water within a bubble supply cell.

5. A method as claimed in Claim 4 when dependent upon Claim 3, wherein the surfactant is present in an amount of from 0.0001 to 0.1 percent by weight of the water within the cell.

6. A method as claimed in Claim 4 or Claim 5, wherein the bubbles are produced electrolytically by the use of from 0.5 to 50 ampere minutes per gallon of water.

7. A method as claimed in Claim 6, wherein the bubbles are produced by the use of from 1.5 to 8 ampere minutes per gallon of water.

8. A method as claimed in any one of the preceding claims, wherein the zone of bubbles containes from 10^4 to 10^{10} bubbles per liter of water.

9. A method as claimed in Claim 8, wherein the zone of bubble contains from 10^6 to 10^9 bubbles per liter of water.

10. A method as claimed in any one of the preceding claims, wherein the diameters of the bubbles are from 10 to 500 microns.

11. A method as claimed in Claim 10, wherein the diameters of the bubbles are from 10 to 100 microns.

12. A method as claimed in any one of the preceding claims, wherein the bubbles occupy from 0.1 to 10% of the volume of the zone of bubbles.

13. A method as claimed in Claim 12

wherein the bubbles occupy from 0.3 to 2% of the volume of the zone of bubbles.

14. A method as claimed in any one of the preceding claims, wherein contact of the bubbles with the pollutants to form aggregates of bubbles and pollutants is accomplished in from 6 seconds to 2 minutes.

15. A method as claimed in any one of the preceding claims, wherein the aggregates of bubbles and pollutants constitute an embryo floc, a flocculant being added to the embryo floc to form a separable floc, the separable floc which itself comprises aggregates of bubbles and pollutants, being introduced into the flotation vessel.

16. A method as claimed in Claim 15 wherein the flocculant is a polyelectrolyte.

17. A method as claimed in Claim 15 or Claim 16, wherein the flocculant is added to produce a concentration of from 1/2 to 15 ppm.

18. A method as claimed in any one of Claims 15 to 17, wherein the separable floc has a density of from 0.7 to 0.9.

19. A method as claimed in any one of the preceding claims wherein the bubble supply is provided by electrolytically decomposing an aqueous fluid that is introduced below the bubble supply.

20. A method as claimed in Claim 19, wherein the aqueous fluid contains ionic species in concentrations of from 0.005 to 0.05 Normal.

21. A method as claimed in Claim 20, wherein the ionic species includes chloride ions for liberating chlorine as a disinfecting agent.

22. A method as claimed in any one of the preceding claims, wherein the step of separation is accomplished by skimming.

23. A method as claimed in any one of the preceding claims, wherein the separation step is assisted by supplying gas bubbles originating near a bottom surface of the separation vessel.

24. A method as claimed in any one of the preceding claims, wherein the water treated is raw wastewater.

25. A method for removing pollutants from water, substantially as hereinbefore described with reference to the accompanying drawings.

26. Apparatus for carrying out the method claimed in Claim 1, which apparatus comprises a closed treatment vessel having an inlet and an outlet at respective ends of a flow path therethrough for water to be treated, a bubble supply in said vessel below the flow path of the water for establishing a zone of fine bubbles in the flow path of the water to form pollutant-bubble aggregates in the water, and a flotation vessel connected by a conduit to the outlet from the treatment vessel.

27 Apparatus as claimed in Claim 26, wherein the bubble supply is housed in a cell disposed in the treatment vessel below the flow path of the water.

28. Apparatus as claimed in Claim 26 or Claim 27, which includes a coagulant injector for injecting coagulant into a conduit for passage of water to be treated to the inlet of the treatment vessel.

29. Apparatus as claimed in Claim 28 wherein the inlet conduit communicates with an injector for introducing a compound to adjust the pH of the wastewater.

30. Apparatus as claimed in any one of Claims 27 to 29, wherein an aqueous fluid injector is in communication with the cell for adding an aqueous fluid thereinto.

31. Apparatus as claimed in any one of Claims 27 to 30 which includes a flocculant injector communicating with the conduit from the treatment vessel to the flotation vessel.

32. Apparatus as claimed in Claim 30 or Claim 31 wherein the cell contains as the bubble supply a plurality of electrodes connected to a power source.

33. Apparatus as claimed in Claim 32 wherein the electrodes are constructed of a ferrosilicon alloy, carbon, graphite, aluminum, a lead-antimony-silter alloy, platinum, palladium-coated titanium, platinized titanium, platinized niobium, platinized tantalum, or a metal coated with ruthenium oxide.

34. Apparatus as claimed in Claim 32 or Claim 33 wherein the electrodes are substantially parallel to each other and spaced apart at a distance of from 1/16 inch to 2 inches.

35. Apparatus as claimed in Claim 33 wherein the electrodes are ferrosilicon alloy rods, the vessel being cylindrical, arranged with its axis horizontal the inlet being at one end of the vessel, the outlet being at the other end and the inlet being lower than the outlet.

36. Apparatus as claimed in Claim 35, wherein the electrodes are spaced apart at a distance of from 1/2 to 2 inches.

37. Apparatus as claimed in any one of Claims 32 to 34 wherein the electrodes are alternately connected to one of two electrode connecting members positioned on opposite ends of the electrodes so as to form two facing fork-shaped electrode units, the electrodes from one fork-shaped electrode unit alternating with and being spaced between and substantially parallel to electrodes from the other fork-shaped electrode unit, the spacing of adjacent electrodes being from 1/16 to 1 inch.

38. Apparatus as claimed in Claim 36

wherein the spacing of adjacent electrodes is from 1/16 to 1/4 inch.

39. Apparatus as claimed in Claim 30 or Claim 31 wherein the bubble supply comprises a compression means for dissolving a gas in the aqueous liquid; the compression means including a cylinder and a piston slidably positioned therein, a gas inlet member in communication therewith and a means for introducing an aqueous fluid into the compression means. and the compression means being in communication with the cell whereby, in use, gas is dissolved in the aqueous fluid in the compression means and is introduced into the cell to thereby generate bubbles.

40. Apparatus as claimed in Claim 30 or Claim 31 wherein the bubble production means comprises a blender for dispersing a gas within the aqueous fluid; the blender including a plurality of mixing blades rotatably mounted therein, means for rotatably driving the blades, a gas inlet member in communication with the blender, and means for introducing the aqueous fluid into the blender; the blender being in communication with the cell whereby, in use, gas is dispersed in the aqueous fluid in the blender and introduced into the cell to thereby generate bubbles.

41. Apparatus for removing pollutants from water, substantially as hereinbefore described with reference to and as shown in Figures 1, 2 and 3, 1, 4 and 5, 1 and 6, 1 and 7, or any of these four combinations in further combination with Figure 8 of the accompanying drawings.

42. Apparatus as claimed in any one of Claims 26 to 41, when used in a method as claimed in Claim 1.

43. A method for removing pollutants from water, substantially as hereinbefore described with reference to the accompanying drawings.

44. A method for removing pollutants from water, substantially as hereinbefore described in any one of the Examples.

45. Water which has been purified by a method as claimed in any one of Claims 1 to 25.

46. Pollutants which have been removed from water by a method as claimed in any one of Claims 1 to 25.

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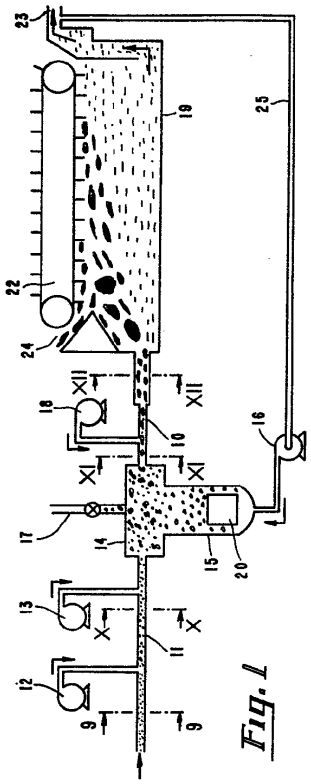

Fig. 1

Fig. 12

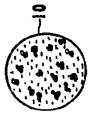

Fig. 11

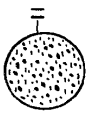

Fig. 10

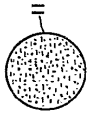

Fig. 9

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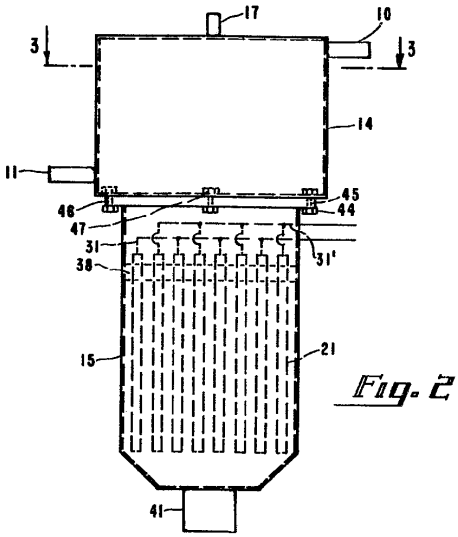

Fig. 2

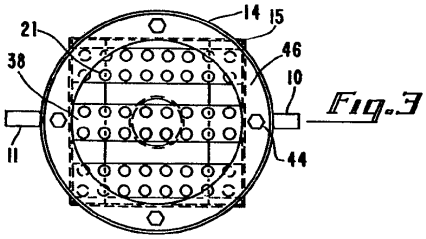

Fig. 3

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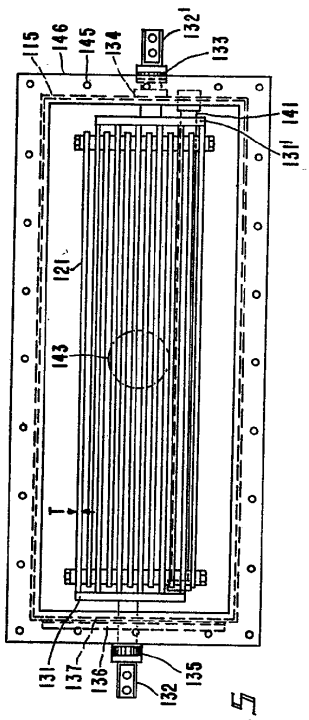

Fig. 5

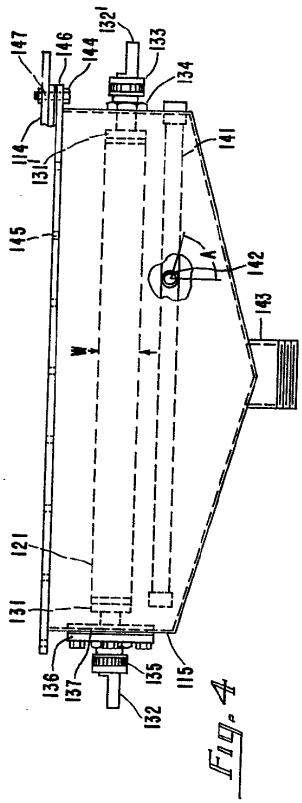

Fig. 4

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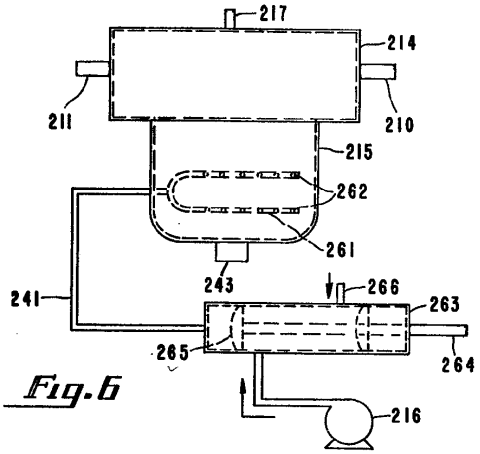

Fig. 6

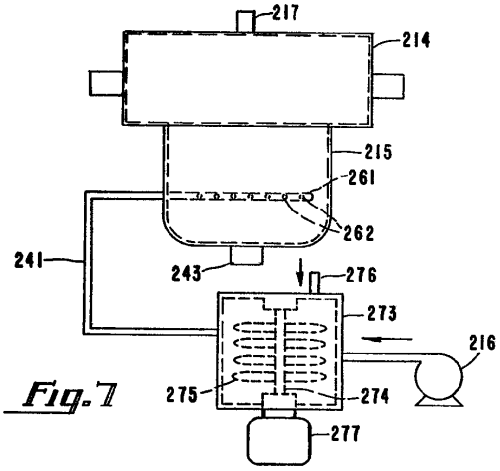

Fig. 7

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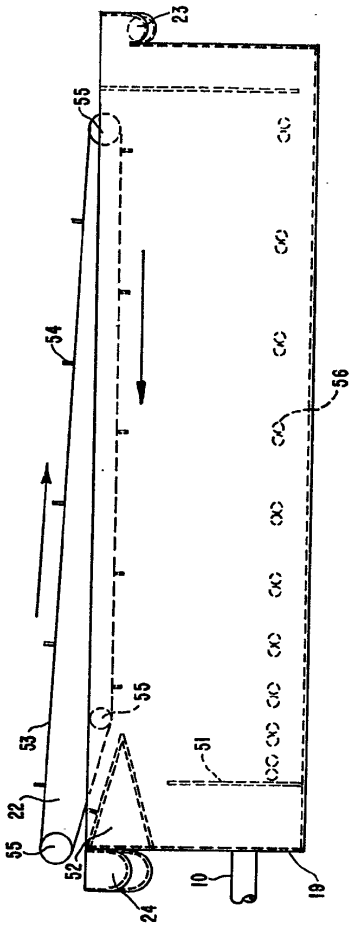

Fig. 8

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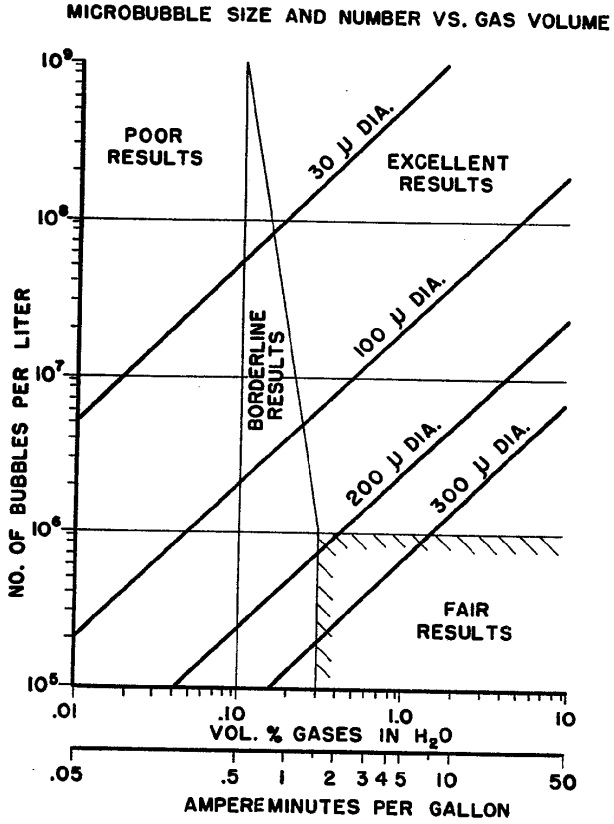

Fig. 13

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Application Number:	12023431
International Application Number:	
Confirmation Number:	7381
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First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	24113
Filer:	J. Paul Haun/Valerie Mitchell
Filer Authorized By:	J. Paul Haun
Attorney Docket Number:	4056.02US03
Receipt Date:	04-APR-2008
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Time Stamp:	16:23:28
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1	Information Disclosure Statement (IDS) Filed	4056_02US03_IDS.pdf	572163 563eeadce8e106bd7edcd8671eab34a56839bdc5	no	3
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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:	Attorney Docket No.: 4056.02US03
Senkiw	Confirmation No.: 7381
Application No.: 12/023,431	Examiner: Unknown
Filed: January 31, 2008	Group Art Unit: 1797
For: FLOW-THROUGH OXYGENATOR	

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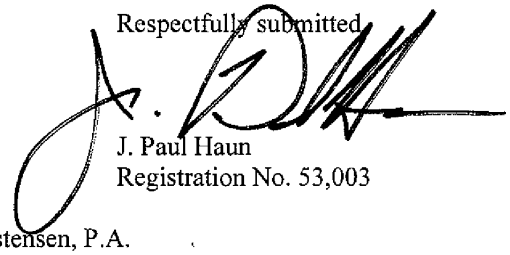

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				Filing Date	January 31, 2008
				First Named Inventor	Senkiw
				Art Unit	1797
				Examiner Name	
Sheet	1	of	2	Attorney Docket Number	4056.02US03

U.S. PATENT DOCUMENTS

EXAMINER INITIAL*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document
		US-6,689,262 B2	02-10-2004	Senkiw
		US-2003/0164306 A1	09-04-2003	Senkiw
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		WO 99/39561	08-12-1999	Mazzei	
		WO 03/072507 A1	09-04-2003	Senkiw	

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		MOHYUDDIN MIRZA ET AL., "Effect of Oxygenated Water on the Growth & Biomass Development of Seedless Cucumbers and Tomato Seedlings under Greenhouse Conditions," Seair Diffusion Systems, 2003, 5 pages, www.seair.ca	

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(74) Agents: PACIULAN, Richard, J. et al.; Ladas & Parry, Suite 2100, 5670 Wilshire Boulevard, Los Angeles, CA 90036–5679 (US).

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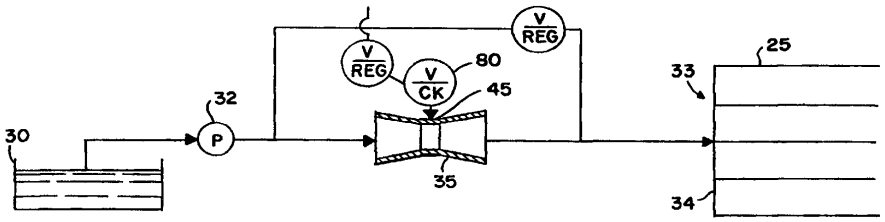

(57) Abstract

An apparatus for beneficiation of soil by infusion of a treatment gas into a pressurized irrigation stream. The apparatus includes a cavitating venturi–type mixer–injector (35) with; a flow passage therethrough, an inlet and an outlet, a constricting portion of decreasing diameter, a cylindrical injector portion for injecting treatment gas into the flow passage, an increasing diameter expanding portion, an impermeable elongated conduit for receiving water and treatment gas from the mixer–injector (33) and a plurality of flow–restricting outlets disposed along the conduit wall permitting limited flow of water without substantial loss of pressure in the conduit. The mixer–injector is adapted to be connected to water source under pressure. Treatment gas will be infused into the water as it flows through the flow passage in the mixer–injector. The water will remain under super–atmospheric pressure until after it passes through the flow–restricting outlet.

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BENEFICIATION OF SOIL WITH DISSOLVED OXYGEN FOR GROWING CROPS

Field of the Invention

This invention relates to the beneficiation of soil in which a crop is grown by supplying beneficial gases to the root region.

Background of the Invention

Growing plants require water, oxygen and potentially other gases to support their life cycle. The water for most crops is derived from interstices in soil, which obtain it from rainfall or irrigation. Oxygen and other gases are obtained from the interstices, either from atmospheric gases which have migrated into the soil or from water in which the gases are dissolved. Although many gases can be beneficial to various crops, oxygen is one of the more important ones, and hence it will be dealt with specifically in this discussion, but this invention is not to be limited to the beneficial affects of oxygen only.

Generally, the concentration of oxygen or other gases in irrigation water is limited to that which is dissolved in accordance with Henry's Law. This is adequate for growth of crops. Farmers and growers of plants are fully aware of the range of wetness that a plant can tolerate. If the soil is maintained too wet for a substantial length of time, it will partially suffocate the microbial activity necessary for plant food conversion for plant uptake. It will, in effect drown. Too long a dry period will result in a lack of moisture to support plant transpiration even though there is plenty of oxygen in the soil.

Accordingly, with present practices, a plant grows best when it is alternately wetted and permitted to approach dryness. The grower attempts to provide adequate moisture and adequate oxygen to support varying transpiration ratios due to fluctuating weather conditions. Commercial intensive agricultural practice supplies oxygen as a function of the correct supply of oxygen dissolved in water, and as a function of air which is drawn into the soil as water is withdrawn from the interstitial spaces in the soil. However these sources can be quite variable. Well water, for example, tends to have less dissolved oxygen, and often contains undesirable other gases. The oxygen content in water supplied in ditches and furrows can vary depending on

water temperatures and ambient conditions.

It is an object of this invention to control and to improve the supply of oxygen to the soil, and thereby improve the growth of the plant or crop. The terms "plant" and "crop" are used interchangeably herein.

This is a fundamental problem, and efforts have been made and suggested to improve the oxygen supply by aerating irrigation water. This can indeed increase the oxygen concentration in the water, but it does not address the issue of what gas content actually reaches all plants in an area of significant size. Previous efforts have achieved some disappointingly limited improvement. For example they have not provided an optimal increase in production by weight, uniform improvement over a substantial area, or significant advancement of maturity of the plants. Their small improvement has been commercially insignificant.

This invention does provide these improvements. For example, adjacent plots of land near Bakersfield, California were planted with bell pepper plants spaced about 12-14 inches (30-36 cm) apart, along raised rows about 620 feet (200 m) long between furrows spaced about 40 inches (1 m) apart. A test plot was prepared according to this invention, as will be described below. The control plot was planted the same way, with an identical irrigation system but without the air supply of this invention. The systems were operated identically.

The results were surprisingly and unpredictably favorable. For example, it was found that the peppers reached a given point of maturity with this invention about one week sooner than peppers in the control plot. This was confirmed by observing the presence of a larger proportion of red peppers to green peppers in the test plot sooner than in the control plot. This is not a small matter. Especially at the start of a season, the earlier produce commands immediate purchase and at a premium price. This premium goes straight to the bottom line as profit. In addition an increase in production in weight of crops over the full season of about 5.6% over the control plot was noted, which also is a direct profit from this invention.

Because this invention's effects are substantially uniform over the entire field, maximum production from a plot of significant size can be anticipated. While bell peppers are given as an example of the results of using this invention, other crops may expect beneficial results, also.

As a further advantage, the plants are less stressed while growing and producing. The

average stress index of the control plot for the season was about -5.52, while the test plots had an index of about -5.76. A larger negative number is the better.

It is an object of this invention to provide a practical means to beneficiate the soil for the above purpose. By the term "beneficiate" is meant addition of a substance to improve the soil's microbial activity for better plant food uptake as a total body by the injection of air/oxygen into the vital root zone area of the plant including moisture for the intended purpose. It is not used in the sense of the addition of a chemical such as gypsum or fertilizer which is used to change the chemical constituents of the soil itself.

Brief Description of the Invention

A system to beneficiate soil according to this invention is intended to supply water and air/oxygen along with other potentially beneficial gases to the subsurface root region of the plant. It is intended to be useful over a substantial area of cropland. As an example, an area of 4.8 acres (19,400 m^2 or 1.94 ha), with rows as long as 620 (200m) feet, and from a single supply, as many as 98 of these rows can readily be treated by this invention. Treated water is to be released beneath the surface of the soil or beneath a covering for the soil such as a mulch. A plastic sheet is regarded as a mulch, although its principal purpose is to control weeds.

An example of a system for this purpose is drip irrigation in which water under system pressure is released through spaced-apart emitters directly into the subsurface soil near the plant rather than being applied to the surface or in furrows. Until the water is released from the emitter, it remains under system pressure so that it contains more dissolved oxygen and other gases than it would under atmospheric pressure, and it will also contain very small micro bubbles of oxygen and other gases such as nitrogen which have not dissolved, especially when air is used as the source of oxygen. As a consequence, when this water is released from system pressure to atmospheric pressure, the released water will then carry a dissolved amount of oxygen respective to this lower pressure, and will release in the soil the excess oxygen which was dissolved at system pressure. It will also release such gases including oxygen as may have existed in micro bubbles.

Importantly, because the system is under pressure, the quality of the mixture of oxygen-rich water and micro-bubbles remains substantially uniform throughout the entire pressured

system. Some coalescencing of the micro-bubbles can be expected, but because of their small size and dispersion, coalescence into major bubbles will not be appreciable. Therefore the water delivered through all exit orifices is substantially uniform so that every plant will be treated consistently.

It will be noted that this arrangement will compensate for the absence of oxygen from the atmosphere into the soil when covered by an impermeable plastic sheet (mulch).

According to one aspect of this invention, oxygen, oxygen containing gases such as air, and other gases beneficial for soil treatment, are injected into the water stream through a mixer-injector. The mixer-injector has a flow passage therethrough with a constricting portion, an injection portion, and an expanding portion in that order. Treatment gas enters the injection portion through an injection port.

The mixer-injector is a cavitating type which produces a reduced pressure in the injection portion, and turbulence in the injection portion. The turbulence disperses the treatment gas throughout the stream. It also reduces the size of the bubbles while it also increases their number.

According to a preferred but optional feature of this invention, the turbulence, distribution and reduction in bubble size may be improved by providing twisting vanes in the constricting portion and straightening vanes in the expanding portion. The stream from the expanding portion proceeds to a user system which may include one or more manifolds, and from there through tubing to points of discharge. It is maintained under pressure until it leaves the tubing. The rate of flow through this system and its length allow sufficient time for the oxygen or other gases to be dissolved to saturation level. The bubbles produced by this mixer-injector are small enough that they do not appreciably coalesce or rise to a surface. They tend to be discharged through the emitter along with the water.

According to a preferred but optional feature of the invention, the treatment gas is air, used for its oxygen content, as well as other potentially beneficial gases.

The above and other features of this invention will be fully understood from the following detailed description and the accompanying drawings, in which:

Brief Description of the Drawings

Fig. 1 is schematic illustration of an irrigation system according to the preferred embodiment of this invention;

Fig. 2 is a schematic cross-section of a localized region where water is being emitted;

Fig. 3 is an axial cross-section of the mixer-injector used in this invention;

Fig. 4 is a left hand end view of Fig. 3;

Fig. 5 is a right hand end view of Fig. 3; and

Fig. 6 is a longitudinal cross-section of a fragment of typical drip irrigation tubing showing an emitter suitable for use with this invention; and

Fig. 7 is a cross-section taken at line 7-7 in Fig. 6.

Detailed Description of the Invention

The object of this invention is to provide a supply of water and oxygen and/or other potentially beneficial gases to soil in the root area of a growing plant. The presently-preferred example of its use is in drip irrigation where, as shown in Fig. 2, a plant 20 is grown in soil 21 having a surface 22. For some crops, a plastic sheet 23 (regarded as a "mulch" for its weed resisting capability) or organic mulch is applied over the surface of the soil near the plant. Water supplied by this system will ordinarily be discharged about 6-10 inches (15-25 cm) below the soil surface.

As shown, a drip irrigation tubing 25 extends along a row 26. At intervals its wall is pierced by emitters 27 (Fig. 6). An emitter is simply an orifice of some kind through which water will flow from the tubing into the soil region at a regulated rate, under designated system pressure. There is a pressure drop across the emitters from system pressure, usually about 10-20 psig to atmospheric pressure.

The pressure drop at the discharge sites is of considerable importance to this invention. The reason is the higher concentration of oxygen and/or other gases that exist in the water at the higher pressure according to Henry's law. However, there is more to it than that, because frequently agricultural water supplies are not fully saturated with oxygen. In this invention, super saturation at atmospheric and system pressure can be assured, so that extra oxygen will be released from solution as the pressure drops, plus additional oxygen in the gas content of the micro bubbles that are produced. This water stream is very rich in the treatment gas.

A water source 30, such as a well, a pond, or a water main supplies water to be pressurized by a pump 32 to system pressure. If the source is a main and pressure in the main is adequate, a pump will be unnecessary. Its output is provided to a distribution system 33 which includes such conventional valves, regulators, and other controls as may be suitable. The system may include headers 34 extending along the heads of the rows 26 of crops. From the headers, flexible drip irrigation tubings 25 extend along the rows or to any desired location where the emitters 27 are to be placed. Applications other than in rows is contemplated, for example in groups of emitters around a tree, and a series of trees.

The mixer-injector 35, best shown in Fig. 3 optimally produces the desired beneficiated water. It receives water from the pump and passes it to the distribution system. Injector-mixers such as those shown in Mazzei United States patent No.4,123,800, issued October 31, 1978 are cavitating types which will in fact increase the oxygen and/or other gases content of water by drawing gas into the stream, and creating micro-bubbles. Such mixer-injectors are useful in this invention. However, the increased turbulence and shear in the illustrated mixer-injector produces smaller micro-bubbles and distributes them better, thereby providing an improved and more stable mix. Both types of mixer-injectors assure that oxygen and/or other gas saturation can be attained, and that the bubbles will be so small that they will minimally gas-out of the water in the time span generally involved in flow through systems such as these, but the mixer-injector shown in Fig. 3 provides surprisingly-improved results.

Full details of mixer-injector 35 will be found in applicant's United States Patent No. 5,863,128 issued January 26, 1999 entitled "Mixer-Injectors With Twisting and Straightening Vanes" which is incorporated herein in its entirety for its detailed showing of the construction and theory of operation of this mixer-injector. For purposes of this invention, it is sufficient to describe its basic elements.

Full details of a less-effective, but still useful mixer-injector for use with this invention will be found in the said Mazzei patent No. 4,123,800, which is incorporated herein in its entirety for its showing of such a mixer-injector. It lacks certain vanes yet to be described, which provide important advantages.

Mixer-injector 35 has a body 36 with a flow passage 37 extending from an entry port 38

to an exit port 39. An internal wall 40 forming the flow passage includes, from the entry port in this order, a cylindrical entry portion 41, a constricting portion 42, an injection portion 43, and an expanding portion 44 which terminates at exit port 39.

An injection port 45 enter the injection portion near to the constricting portion. It preferably exists as a circumferential groove 46 in the internal wall, communicating with a passage 47 that receives treatment gas to be provided to the stream in the flow passage, for example from atmospheric air. A metering valve and a check valve 80 are placed in passage 45 to provide a unidirectional flow of the correct amount of oxygen.

It is convenient to regulate the pressure and flow rate by means of establishing a flow and pressure drop through a regulator valve (which may be a flow restrictors instead) in a by-pass passage across the mixer-injector.

To this point, the mixer-injector shown in the said Mazzei '800 patent is described, and is useful. However, additional features as shown in the said Mazzei patent application provide importantly improved performance. These features are twisting vanes 48 in the constricting portion, and straightening vanes 49 in the expanding portion.

The twisting vanes 48 are provided as a group (eight is a useful number) of individual vanes with crests which as they extend along the central axis 50 of the flow passage also extend at an acute angle 51 to a plane passed through them and which includes the central axis. They rise from the entry portion into the constricting portion. They do not intersect the central axis. They give a twist to the outer region of the stream, so that when it crosses the injection port it has an increased turbulence caused by the confluence of the central "core" of the stream (which is not twisted) and the outer portion (which is twisted). This increased turbulence results in a more thorough mixing of the water and the treatment gas, and the reduction of size of the micro-bubbles, all to the advantage of this process.

Once this is attained, it is advantageous for the turbulence to be reduced, while still further shearing the micro-bubbles. This is accomplished by the group of straightening vanes 49, which extend along the expanding portion. They have crests 51 that are preferably parallel to the central axis, and are spaced apart from it. From exit port 39, the stream enters the distribution system extending to the plants.

As previously stated, emitters 27 are placed along the length of the tubing. Their characteristic is to provide for a slow bleed of water from the tubing into the subsoil. Such emitters are well-known and of several types. They constitute, in effect, a bleed valve that permits a very limited rate of flow of fluid therethrough, so the pressure in the tubing is not materially reduced, and the contents remain under pressure throughout the system.

A typical useful emitter 60 is shown formed as part of a drip irrigating tubing 61. In this emitter, the main passage 62 is formed by a wall 63. Longitudinal edges 64, 65 of the wall are overlapped to leave a restricted channel 66 between overlapped margins 67, 68. A series of inlet ports 69 is formed from passage 62 into channel 66. These ports are small and enter at numerous locations along the overlaps. The channel may further restricted by internal diverters or by serpentine passages which further reduce the rate of flow of water through channel 66. At one end of channel 66, a longitudinal slit 71 through the outer overlap releases the water from channel 66 to atmosphere.

There are other types of emitters, including small orifices through the wall of the tubing. Any emitter capable of establishing a regulated rate of fluid flow from passage 62 is acceptable.

The operation of this system will be evident from the foregoing. With the desired throughput of water per unit time decided upon, a suitably sized mixer-injector will be selected and plumbed into the system. The flow through the injection portion will establish a subatmospheric pressure in that portion which will draw treatment gas into the injection portion. The rate of flow of this gas will be adjusted by valve 55 to pass the gas at a suitable flow rate for the purposes intended.

Some treatment gas drawn into the mixer-injector will be dissolved and the remainder will be divided into micro-bubbles as described, and will flow into the system, ultimately to and through the emitters. The drip irrigation tubing is impermeable. Water and gases can leave only through the emitters (or other flow-limiting outlets, of which emitters and orifices are only two examples). The existing fluids have substantially the same water/gas mix at that point as at all other locations in the system downstream from the mixer-injector.

In a system as previously described, water was supplied to a two 2 inch mixer-injector sold by Mazzei Injector Corporation as its part No. 2081. It is constructed a shown in Fig. 3,

and as further disclosed in detail in the said Mazzei patent application. Water flowed through the system at the rate of about 260 gallons per minute and air was drawn into it at the rate of approximate 3.5 SCFM. Flow was intermittently supplied, on the average about 2 hours every 3 days and more frequently as the plant grows.

Accordingly, the soil will be beneficiated by the concurrent addition of water and treatment gas. It provides an improvement in growing conditions because it ultimately promotes a healthier plant root. Systems can be provided with the use of this invention which allow far less plant stress under varying weather conditions and watering intervals.

This invention is not to be limited by the embodiments shown in the drawings and described in the description, which are given by way of example and not of limitation, but only in accordance with the scope of the appended claims.

I CLAIM:

1. Apparatus for beneficiation of soil by infusion of a treatment gas into a pressurized irrigation stream, said apparatus comprising:

a cavitating venturi-type mixer-injector having a body with an internal wall forming a flow passage therethrough, said flow passage having a central axis, an inlet, an outlet, and between said inlet and outlet said wall forming a constricting portion of decreasing diameter, a substantially cylindrical injector portion, and an expanding portion having an increasing diameter all as they progress in that order from inlet to outlet, an injection port, said injector port receiving treatment gas from a source of gas for injection into said flow passage;

an impermeable elongated conduit having a length and a peripheral wall forming a longitudinal passage for receiving water and treatment gas from said mixer-injector;

a plurality of flow-restricting outlets disposed along the length of said conduit wall, passing through said conduit wall to permit limited flow of water from said longitudinal passage without substantial loss of pressure in said conduit;

said mixer-injector adapted to be connected to a source of water under pressure, whereby treatment gas will be infused into said water as it flows through the flow passage in the mixer injector, and said water will remain under super-atmospheric pressure until after it passes through a said flow-restricting outlet.

2. Apparatus according to claim 1 in which said flow restricting outlets are emitters either internal or external.

3. Apparatus according to claim 1 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

4. Apparatus according to any one of claims 1-3 in which a plurality of straightening vanes extend along at least a part of the expanding portion, said straightening vanes being

parallel to said central axis, but being spaced from said central axis.

5. Apparatus according to claim 4 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

6. Apparatus according to claim 5 in which said flow restricting outlets are emitters, either internal or external.

7. In combination:

crop growing soil in which a rooted crop is to be grown, said soil having a top surface; and

apparatus for beneficiation of said soil by infusion of a treatment gas into a pressurized irrigation stream of water, said apparatus comprising:

a cavitating venturi-type mixer-injector having a body with an internal wall forming a flow passage therethrough, said flow passage having a central axis, an inlet, an outlet, and between said inlet and outlet said wall forming a constricting portion of decreasing diameter, a substantially cylindrical injector portion, and an expanding portion having an increasing diameter all as they progress in that order from inlet to outlet, an injection port, said injector port receiving treatment gas from a source of gas for injection into said flow passage;

an impermeable elongated conduit having a length and a peripheral wall forming a longitudinal passage for receiving water and treatment gas from said mixer-injector;

a plurality of flow-restricting outlets disposed along the length of said conduit wall beneath said top surface, passing through said conduit wall to permit limited flow of water from said longitudinal passage without substantial loss of pressure in said conduit;

said mixer-injector adapted to be connected to a source of water under pressure, whereby treatment gas will be infused into said water as it flows through the flow passage in the mixer injector, and said water will remain under super atmospheric pressure until

after it passes through a said flow-restricting outlet.

8. Apparatus according to claim 7 in which said flow restricting outlets are emitters, either internal or external.

9. Apparatus according to claim 7 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

10. Apparatus according to any one of claims 7-9 in which a plurality of straightening vanes extend along at least a part of the expanding portion, said straightening vanes being parallel to said central axis, but being spaced from said central axis.

11. Apparatus according to claim 10 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

12. Apparatus according to claim 11 in which said flow restricting outlets are emitters either internal or external.

13. A method to improve growing conditions for crops which are grown in soil that has a top surface:

utilizing apparatus for beneficiating soil by infusion of a treatment gas into an irrigation stream of water, said apparatus comprising:

a cavitating venturi-type mixer-injector having a body with an internal wall forming a flow passage therethrough, said flow passage having a central axis, an inlet, an outlet,

and between said inlet and outlet said wall forming a constricting portion of decreasing diameter, a substantially cylindrical injector portion, and an expanding portion having an increasing diameter all as they progress in that order from inlet to outlet, an injection port, said injector port receiving treatment gas from a source of gas for injection into said flow passage;

an impermeable elongated conduit having a length and a peripheral wall forming a longitudinal passage for receiving water and treatment gas from said mixer-injector;

a plurality of flow-restricting outlets disposed along the length of said conduit wall, passing through said conduit wall to permit limited flow of water from said longitudinal passage without substantial loss of pressure in said conduit;

said mixer-injector adapted to be connected to a source of water under pressure, whereby treatment gas will be infused into said water as it flows through the flow passage in the mixer injector, and said water will remain under super atmospheric pressure until after it passes through an emitter buried in said conduit beneath said top surface;

forcing a stream of water under pressure into the entry port of said mixer injector, while admitting air into said injection portion through said injection port, thereby providing in said longitudinal passage a water stream under atmospheric pressure enriched with treatment gas, said emitters permitting limited flow of said stream into said soil.

14. The method according to claim 13 in which said flow restricting outlets are emitters.

15. The method according to claim 13 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

16. The method according to any one of claims 13-15 in which a plurality of straightening vanes extend along at least a part of the expanding portion, said straightening vanes being parallel to said central axis, but being spaced from said central axis.

17. The method according to claim 16 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

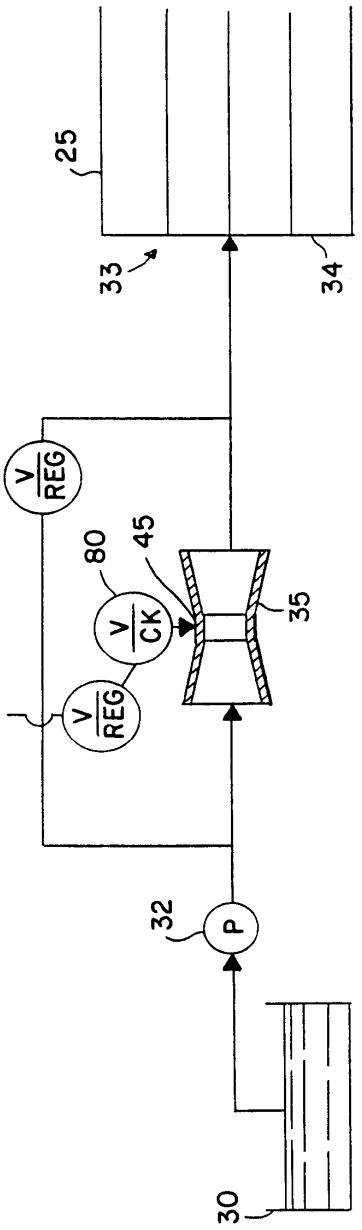

FIG. 1

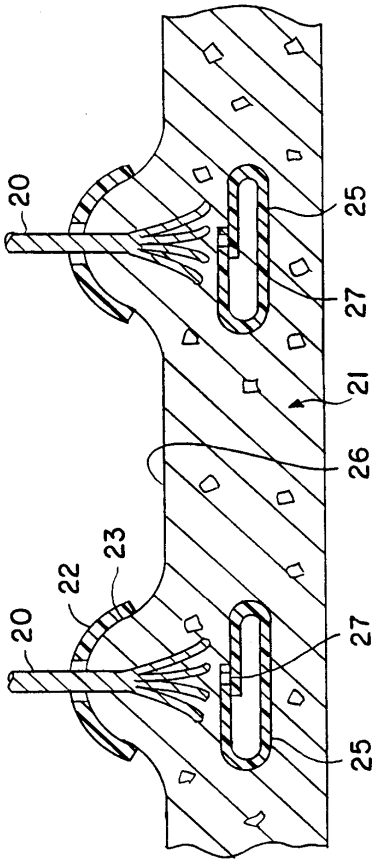

FIG. 2

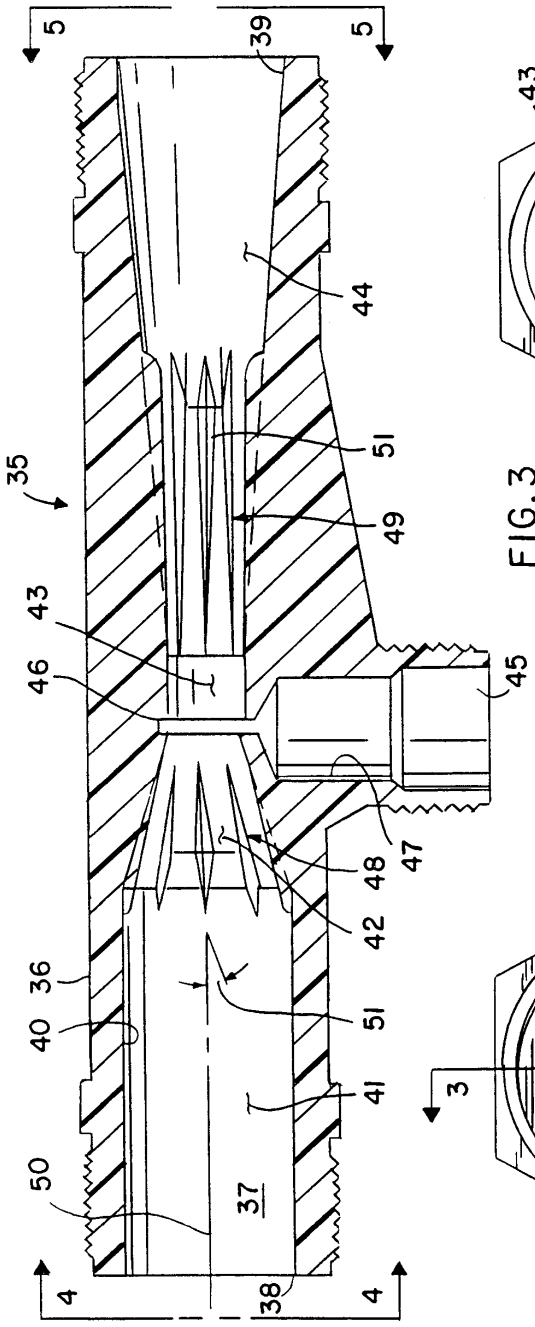

FIG. 3

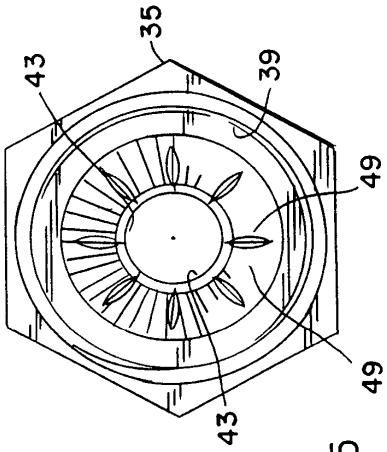

FIG. 5

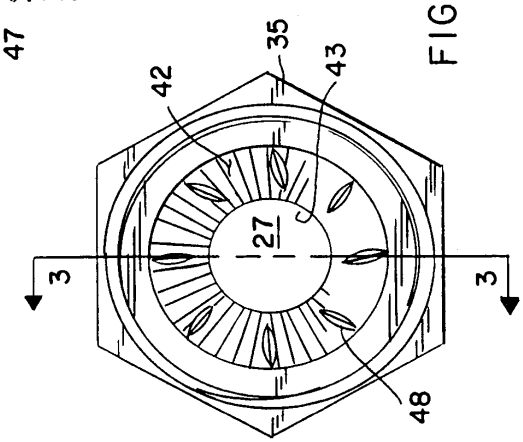

FIG. 4

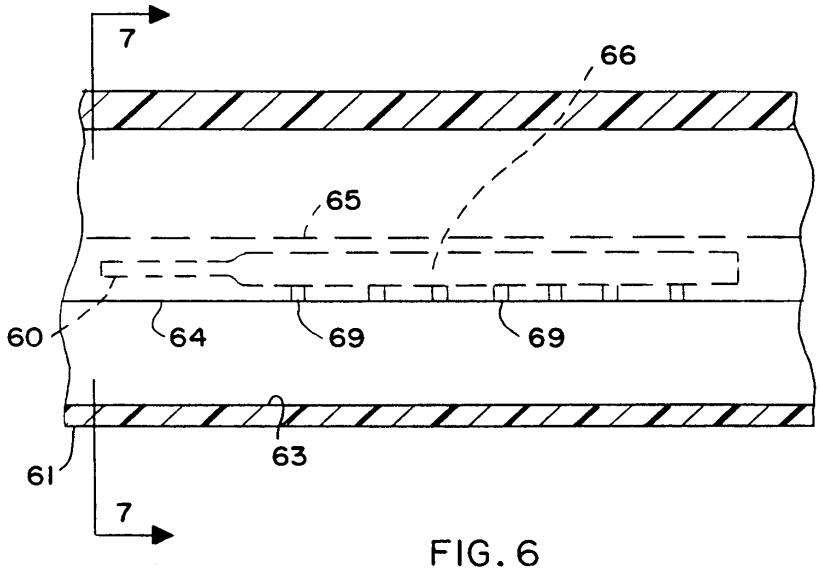

FIG. 6

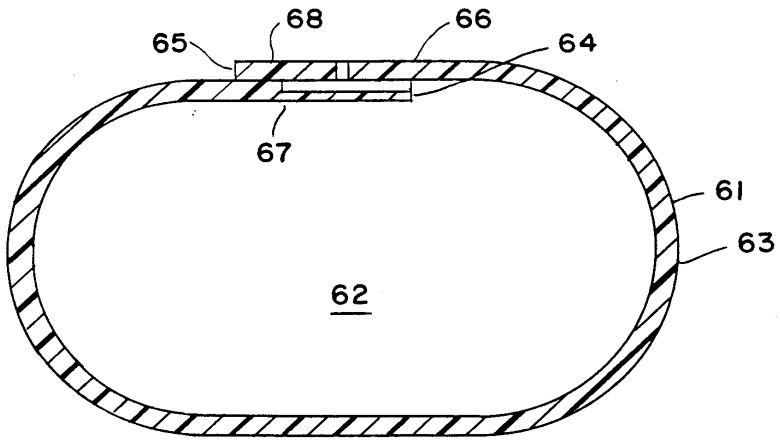

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/02779

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :A01B 39/00
US CL :47/58,1.01F
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 47/58, 48.5, 1.01F; 366/150, 163.2

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 1,200,869 A (RIFE) 10 October 1916 (10.10.16), pages 1-2 and Figures 1-2.	1,7,13 2,6,8,12,14,17
X,P	US 5,863,128 A (MAZZEI) 26 January 1999 (26.01.99), cover page Abstract and Figure 1.	3-5, 9-11, 15-17
Y	US 5,697,187 A (PERSINGER) 16 December 1997 (16.12.97), cover page Abstract and Figure-1.	1,7,13
Y	US 3,046,747 A (TIMPE) 31 July 1962 (31.07.62), see entire document, especially columns 4-6.	1,7,13 2,6,8,12,14,17

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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Date of the actual completion of the international search
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/02779

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,123,800 A (MAZZEI) 31 October 1978 (31.10.78), cover page Abstract, columns 3-4 and Figure-1.	1,7,13

Form PCT/ISA/210 (continuation of second sheet)(July 1992)★

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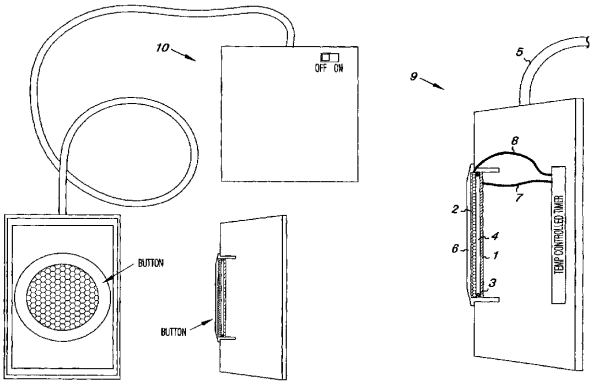
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MICROBUBBLES OF OXYGEN



(57) Abstract: An oxygen emitter (6) which is an electrolytic cell is disclosed. When the anode (1) and cathode (2) are separated by a critical distance, very small microbubbles and nanobubbles of oxygen are generated. The hydrogen forms bubbles at the cathode, which bubbles rise to the surface. The very small oxygen bubbles remain in suspension, forming a solution supersaturated in oxygen. The very small oxygen bubbles remain in suspension, forming a solution supersaturated in oxygen. The electrodes may be a metal or oxide of at least one metal selected from the group consisting of ruthenium, iridium, nickel, iron, rhodium, rhenium, cobalt, tungsten, manganese, tantalum, molybdenum, lead, titanium, platinum, palladium and osmium or oxides thereof. The electrodes may be formed into open grids or may be closed surfaces. The most preferred cathode is a stainless steel mesh. The most preferred mesh is 1/16 inch grid. The most preferred anode is platinum and iridium oxide on a support. A preferred support is titanium. Models suitable for different uses are disclosed.

WO 03/072507 A1

MICROBUBBLES OF OXYGEN

FIELD OF THE INVENTION

This invention relates to the electrolytic generation of microbubbles of oxygen for increasing the oxygen content of aqueous media.

BACKGROUND OF THE INVENTION

Many benefits may be obtained through raising the oxygen content of aqueous media. Efforts have been made to achieve higher saturated or supersaturated oxygen levels for applications such as the improvement of water quality in ponds, lakes, marshes and reservoirs, the detoxification of contaminated water, culture of fish, shrimp and other aquatic animals, biological culture and hydroponic culture. For example, fish held in a limited environment such as an aquarium, a bait bucket or a live hold tank may quickly use up the dissolved oxygen in the course of normal respiration and are then subject to hypoxic stress, which can lead to death. A similar effect is seen in cell cultures, where the respiring cells would benefit from higher oxygen content of the medium. Organic pollutants from agricultural, municipal and industrial facilities spread through the ground and surface water and adversely affect life forms. Many pollutants are toxic, carcinogenic or mutagenic. Decomposition of these pollutants is facilitated by oxygen, both by direct chemical detoxifying reactions or by stimulating the growth of detoxifying microflora. Contaminated water is described as having an increased biological oxygen demand (BOD) and water treatment is aimed at decreasing the BOD so as to make more oxygen available for fish and other life forms.

The most common method of increasing the oxygen content of a medium is by sparging with air or oxygen. While this is a simple method, the resulting large bubbles produced simply break the surface and are discharged into the

atmosphere. Attempts have been made to reduce the size of the bubbles in order to facilitate oxygen transfer by increasing the total surface area of the oxygen bubbles. United States Patent Number 5,534,143 discloses a microbubble generator that achieves a bubble size of about 0.10 millimeters to about 3 millimeters in diameter. United States Patent Number 6,394,429 discloses a device for producing microbubbles, ranging in size from 0.1 to 100 microns in diameter, by forcing air into the fluid at high pressure through a small orifice.

When the object of generating bubbles is to oxygenate the water, either air, with an oxygen content of about 21%, or pure oxygen may be used. The production of oxygen and hydrogen by the electrolysis of water is well known. A current is applied across an anode and a cathode which are immersed in an aqueous medium. The current may be a direct current from a battery or an AC/DC converter from a line. Hydrogen gas is produced at the cathode and oxygen gas is produced at the anode. The reactions are:

AT THE CATHODE:	$4H_2O + 4\ e^- \rightarrow 4OH^- + 2H_2$
AT THE ANODE:	$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$
NET REACTION:	$6H_2O \rightarrow 4OH^- + 4H^+ + 2H_2 + O_2$

286 kilojoules of energy is required to generate one mole of oxygen.

The gasses form bubbles which rise to the surface of the fluid and may be collected. Either the oxygen or the hydrogen may be collected for various uses. The "electrolytic water" surrounding the anode becomes acidic while the electrolytic water surrounding the cathode becomes basic. Therefore, the electrodes tend to foul or pit and have a limited life in these corrosive environments.

Many cathodes and anodes are commercially available. United States Patent Number 5,982,609 discloses cathodes comprising a metal or metallic oxide of at least one metal selected from the group consisting of ruthenium, iridium, nickel, iron, rhodium, rhenium, cobalt, tungsten, manganese, tantalum, molybdenum, lead, titanium, platinum, palladium and osmium. Anodes are formed from the same metallic oxides or metals as cathodes. Electrodes may also be formed from alloys of the above metals or metals and oxides co-deposited on a substrate. The cathode and anodes may be formed on any convenient support in any desired shape or size. It is possible to use the same materials or different materials for both electrodes. The choice is determined according to the uses. Platinum and iron alloys ("stainless steel") are often preferred materials due to their inherent resistance to the corrosive electrolytic water. An especially preferred anode disclosed in U. S. Patent Number 4,252,856 comprises vacuum deposited iridium oxide.

Holding vessels for live animals generally have a high population of animals which use up the available oxygen rapidly. Pumps to supply oxygen have high power requirements and the noise and bubbling may further stress the animals. The available electrolytic generators likewise have high power requirements and additionally run at high voltages and produce acidic and basic water which are detrimental to live animals. Many of the uses of oxygenators, such as keeping bait or caught fish alive, would benefit from portable devices that did not require a source of high power. The need remains for quiet, portable, low voltage means to oxygenate water.

RELATED APPLICATIONS

This application claims priority of United States Provisional Patent Application Number 60/358,534, filed February 22, 2002.

SUMMARY OF THE INVENTION

This invention provides an oxygen emitter which is an electrolytic cell which generates very small microbubbles and nanobubbles of oxygen in an aqueous medium, which bubbles are too small to break the surface tension of the medium, resulting in a medium supersaturated with oxygen.

The electrodes may be a metal or oxide of at least one metal selected from the group consisting of ruthenium, iridium, nickel, iron, rhodium, rhenium, cobalt, tungsten, manganese, tantalum, molybdenum, lead, titanium, platinum, palladium and osmium or oxides thereof. The electrodes may be formed into open grids or may be closed surfaces. The most preferred cathode is a stainless steel mesh. The most preferred mesh is a 1/16 inch grid. The most preferred anode is platinum and iridium oxide on a support. A preferred support is titanium.

In order to form microbubbles and nanobubbles, the anode and cathode are separated by a critical distance. The critical distance ranges from 0.005 inches to 0.140 inches. The preferred critical distance is from 0.045 to 0.060 inches.

Models of different size are provided to be applicable to various volumes of aqueous medium to be oxygenated. The public is directed to choose the applicable model based on volume and power requirements of projected use. Those models with low voltage requirements are especially suited to oxygenating water in which animals are to be held.

Controls are provided to regulate the current and timing of electrolysis.

DESCRIPTION OF THE DRAWINGS

Figure 1 is the O_2 emitter of the invention.

Figure 2 is an assembled device.

Figure 3 is a diagram of the electronic controls of the O_2 emitter.

Figure 4 shows a funnel or pyramid variation of the O_2 emitter.

Figure 5 shows a multilayer sandwich O_2 emitter.

DETAILED DESCRIPTION OF THE INVENTION

Definitions:
For the purpose of describing the present invention, the following terms have these meanings:

"Critical distance" means the distance separating the anode and cathode at which evolved oxygen forms microbubbles and nanobubbles.

"O_2 emitter" means a cell comprised of at least one anode and at least one cathode separated by the critical distance.

"Microbubbles" means a bubble with a diameter less than 50 microns.

"Nanobubble" means a bubble with a diameter less than that necessary to break the surface tension of water. Nanobubbles remain suspended in the water, giving the water an opalescent or milky appearance.

"Supersaturated" means oxygen at a higher concentration than normal calculated oxygen solubility at a particular temperature and pressure.

"Water" means any aqueous medium with resistance less than one ohm per square centimeter; that is, a medium that can support the electrolysis of water. In general, the lower limit of resistance for a medium that can support electrolysis is water containing more than 2000 ppm total dissolved solids.

The present invention produces microbubbles and nanobubbles of oxygen via the electrolysis of water. As molecular oxygen radical (atomic weight 8) is produced, it reacts to form molecular oxygen, O_2. In the special dimensions of the invention, as explained in more detail in the following examples, O_2 forms bubbles which are too small to break the surface tension of the fluid. These bubbles remain suspended indefinitely in the fluid and, when allowed to build up, make the fluid opalescent or milky. Only after several hours do the bubbles begin to coalesce on the sides of the container and the water clears. During that time, the water is supersaturated with oxygen. In contrast, the H_2 formed readily coalesces into larger bubbles which are discharged into the atmosphere, as can be seen by bubble formation at the cathode.

The first objective of this invention was to make an oxygen emitter with low power demands, low voltage and low current for use with live animals. For that reason, a small button emitter was devised. The anode and cathode were set at varying distances. It was found that electrolysis took place at very short distances before arcing of the current occurred. Surprisingly, at slightly larger distances, the water became milky and no bubbles formed at the anode, while hydrogen continued to be bubbled off the cathode. At distance of 0.140 inches between the anode and cathode, it was observed that the oxygen formed bubbles at the anode. Therefore, the critical distance for microbubble and nanobubble formation was determined to

the critical distance for microbubble and nanobubble formation was determined to be between 0.005 inches and 0.140 inches.

Example 1. Oxygen emitter:

As shown in Figure 1, the oxygen evolving anode 1 selected as the most efficient is an iridium oxide coated single sided sheet of platinum on a support of titanium (Eltech, Fairport Harbor, OH). The cathode 2 is a 1/16 inch mesh marine stainless steel screen. The anode and cathode are separated by a non-conducting spacer 3 containing a gap 4 for the passage of gas and mixing of anodic and cathodic water and connected to a power source through a connection point 5. Figure 2 shows a plan view of the assembled device. The O_2 emitter 6 with the anode connecting wire 7 and the cathode connecting wire 8 is contained in an enclosure 9, connected to the battery compartment 10. The spacer thickness is critical as it sets the critical distance. It must be of sufficient thickness to prevent arcing of the current, but thin enough to separate the electrodes by no more than 0.140 inches. Above that thickness, the power needs are higher and the oxygen bubbles formed at higher voltage will coalesce and escape the fluid. Preferably, the spacer is from 0.005 to 0.075 inches thick. At the lower limits, the emitter tends to foul more quickly. Most preferably, the spacer is 0.050 inches thick. The spacer may be any nonconductive material such as nylon, fiberglass, Teflon® polymer or other plastic. Because of the criticality of the space distance, it is preferable to have a non-compressible spacer. It was found that Buna, with a durometer measure of 60 was not acceptable due to decomposition. Viton, a common fluoroelastomer, has a durometer measure of 90 and was found to hold its shape well.

In operation, a small device with an O_2 emitter 1.485 inches in diameter was driven by 4AA batteries. The critical distance was held at 0.05 inches with a Viton spacer. Five gallons of water became saturated in seven minutes. This size is suitable for raising oxygen levels in an aquarium or bait bucket.

It is convenient to attach a control circuit which comprises a timer that is thermostatically controlled by a temperature sensor which determines the off time for the cathode. When the temperature of the solution changes, the resistance of the thermistor changes, which causes an off time of a certain duration. In cool water, the duration is longer so in a given volume, the emitter generates less oxygen. When the water is warmer and therefore hold less oxygen, the duration of off time is shorter. Thus the device is self-controlled to use power most economically. Figure 3 shows a block diagram of a timer control with anode 1, cathode 2, thermistor temperature sensor 3, timer control circuit 4 and wire from a direct current power source 5.

Example 2. Measurement of O_2 bubbles.

Attempts were made to measure the diameter of the O_2 bubbles emitted by the device of Example 1. In the case of particles other than gasses, measurements can easily be made by scanning electron microscopy, but gasses do not survive electron microscopy. Large bubble may be measured by pore exlclusion, for example, which is also not feasible when measuring a gas bubble. A black and white digital, high contrast, backlit photograph of treated water with a millimeter scale reference was shot of water produced by the emitter of Example 1. About 125 bubbles were seen in the area selected for measurement. Seven bubbles ranging from the smallest clearly seen to the largest were measured. The area was enlarged, giving a scale multiplier of 0.029412.

Recorded bubble diameters at scale were 0.16, 0.22, 0.35, 0.51, 0.76, 0.88 and 1.09 millimeters. The last three were considered outliers by reverse analysis of variance and were assumed to be hydrogen bubbles. When multiplied by the scale multiplier, the assumed O_2 bubbles were found to range from 4.7 to 15 microns in diameter. This test was limited by the resolution of the camera and smaller bubbles in the

nanometer range could not be resolved. It is known that white light cannot resolve features in the nanometer size range, so monochromatic laser light may give resolution sensitive enough to measure smaller bubbles. Efforts continue to increase the sensitivity of measurement so that sub-micron diameter bubbles can be measured.

Example 3. Other models of oxygen emitter

Depending on the volume of fluid to be oxygenated, the oxygen emitter of this invention may be shaped as a circle, rectangle, cone or other model. One or more may be set in a substrate that may be metal, glass, plastic or other material. The substrate is not critical as long as the current is isolated to the electrodes by the nonconductor spacer material of a thickness from 0.005 to 0.075 inches, preferably 0.050 inches. It has been noticed that the flow of water seems to be at the periphery of the emitter, while the evolved visible bubbles (H_2) arise at the center of the emitter. Therefore, a funnel or pyramidal shaped emitter was constructed to treat larger volumes of fluid. Figure 4 is a cross sectional diagram of such an emitter. The anode 1 is formed as an open grid separated from a marine grade stainless steel screen cathode by the critical distance by spacer 3 around the periphery of the emitter and at the apex. This flow-through embodiment is suitable for treating large volumes of water rapidly.

The size may be varied as required. A round emitter for oxygenating a bait bucket may be about 2 inches in diameter, while a 3-inch diameter emitter is adequate for oxygenating a 10 to 40 gallon tank. The live well of a fishing boat will generally hold 40 to 80 gallons of water and require a 4-inch diameter emitter. It is within the scope of this invention to construct larger emitters or to use several in a series to oxygenate larger volumes. It is also within the scope of this invention to vary the model to provide for low voltage and amperage in cases where the need for oxygen is moderate and long lasting or conversely, to supersaturate water very quickly at

higher voltage and amperage. In the special dimensions of the present invention, it has been found that a 6 volt battery supplying a current as low as 40 milliamperes is sufficient to generate oxygen. Such a model is especially useful with live plants or animals, while it is more convenient for industrial use to use a higher voltage and current. Table I shows a number of models suitable to various uses.

TABLE I

Emitter Model	Gallons	Volts	Amps Max.	Ave	Watts
Bait keeper	5	6	0.090	0.060	0.36
Livewell	32	12	0.180	0.120	1.44
OEM 2 inch	10	12	0.210	0.120	1.44
Bait store	70	12	0.180	0.180	2.16
Double cycle	2	12	0.180	0.180	2.16
OEM 3 inch	50 KT 2-11-03	12	0.500	0.265	3.48
OEM 4 inch	80	12	0.980	0.410	4.92
Water pail	2	24	1.200	1.200	28.80
Plate	250	12	5.000	2.500	30.00

Example 4. Multilayer sandwich O_2 emitter

An O_2 emitter was made in a multilayer sandwich embodiment. (Figure 5) An iridium oxide coated platinum anode 1 was formed into a grid to allow good water flow and sandwiched between two stainless steel screen cathodes 2. Spacing was

held at the critical distance by nylon spacers 3. The embodiment illustrated is held in a cassette 4 which is secured by nylon bolt 5 with a nylon washer 6. The dimensions selected were:

- cathode screen 0.045 inches thick
- nylon spacer 0.053 inches thick
- anode grid 0.035 inches thick
- nylon spacer 0.053 inches thick
- cathode screen 0.045 inches thick,

for an overall emitter thickness of 0.231 inches.

If a more powerful emitter is desired, it is within the scope of this invention to repeat the sequence of stacking. For example, an embodiment may easily be constructed with this sequence: cathode, spacer, anode, spacer, cathode, spacer, anode, spacer, cathode, spacer, anode, spacer, cathode. The number of layers in the sandwich is limited only by the power requirements acceptable for an application.

Those skilled in the art will readily comprehend that variations, modifications and additions may in the embodiments described herein may be made. Therefore, such variations, modifications and additions are within the scope of the appended claims.

I claim:

Claim 1. An emitter for electrolytic generation of microbubbles of oxygen comprising an anode separated at a critical distance from a cathode and a power source all in electrical communication with each other.

Claim 2. The emitter of claim 1 wherein the anode is a metal or a metallic oxide or a combination of a metal and a metallic oxide.

Claim 3. The emitter of claim 1 wherein the anode is platinum and iridium oxide on a support.

Claim 4. The emitter of claim 1 wherein the cathode is a metal or metallic oxide or a combination of a metal and a metallic oxide.

Claim 5. The critical distance of claim 1 which is 0.005 to 0.140 inches.

Claim 6. The critical distance of claim 1 which is 0.045 to 0.060 inches.

Claim 7. An emitter for electrolytic generation of microbubbles of oxygen comprising a plurality of anodes separated at a critical distance from a plurality of cathodes and a power source all in electrical communication with each other.

Claim 8. A method for keeping aquatic animals emitter alive comprising inserting the emitter of claim 1 or claim 7 into the aquatic medium of the aquatic animals.

Claim 9. The method of claim 8 wherein the aquatic animal is a fish.

Claim 10. The method of claim 8 wherein the aquatic animal is a shrimp.

Claim 11. A method for lowering the biologic oxygen demand of polluted water comprising passing the polluted water through a vessel containing the emitter of claim 1.

Claim 12. The product of claim 1 wherein the water is supersaturated with oxygen and of an approximately neutral pH.

Claim 13. An emitter for electrolytic generation of microbubbles of oxygen comprising a platinum-iridium oxide anode on a titanium support separated at a critical distance of from 0.045 inches to 0.060 inches from a stainless steel screen 1/16 inch thick cathode all in electrical communication with a battery.

Claim 14. The emitter of claims 1, 7 or 13 further comprising a timer control.

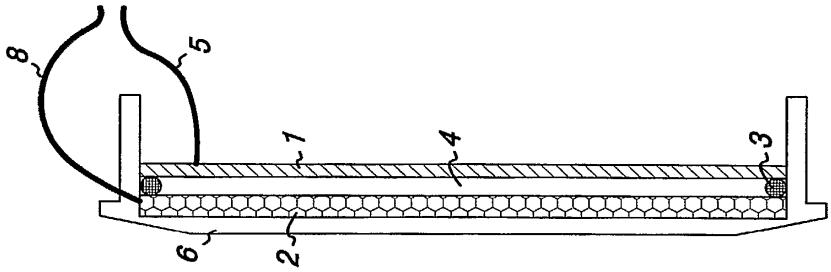


Fig. 1B

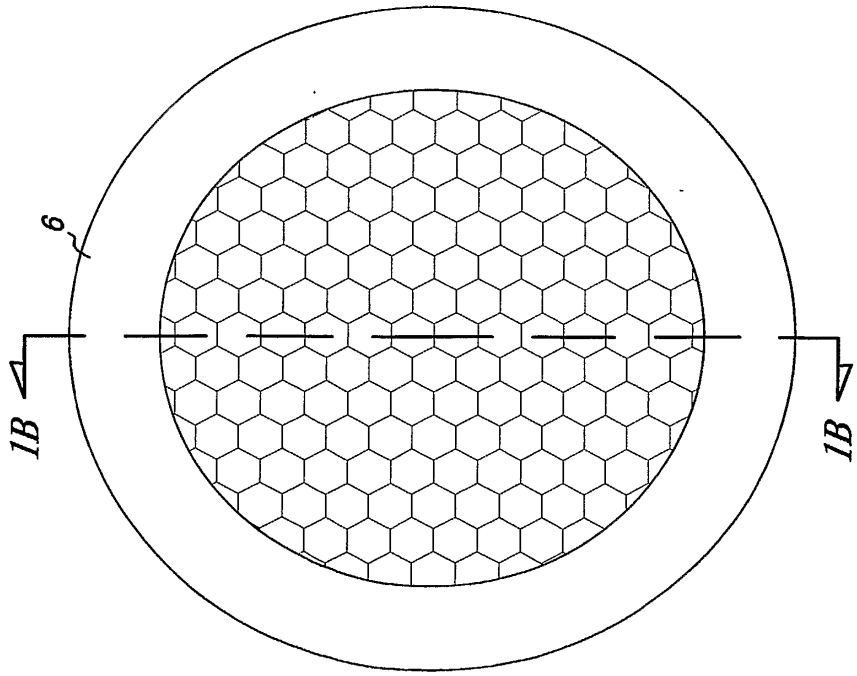


Fig. 1A

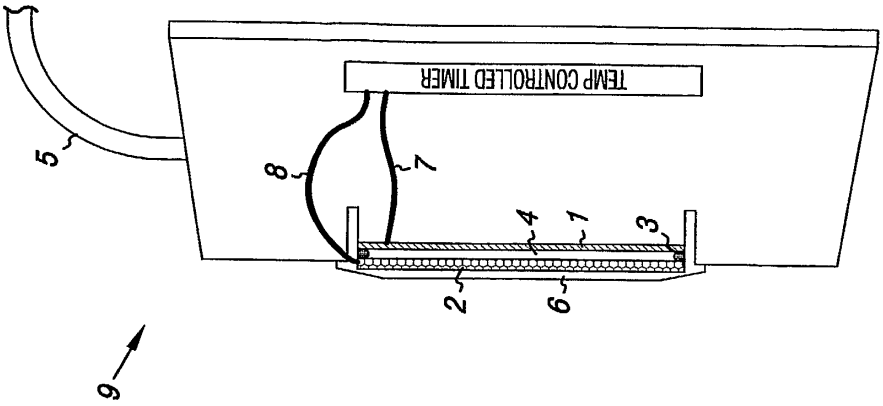


Fig. 2B

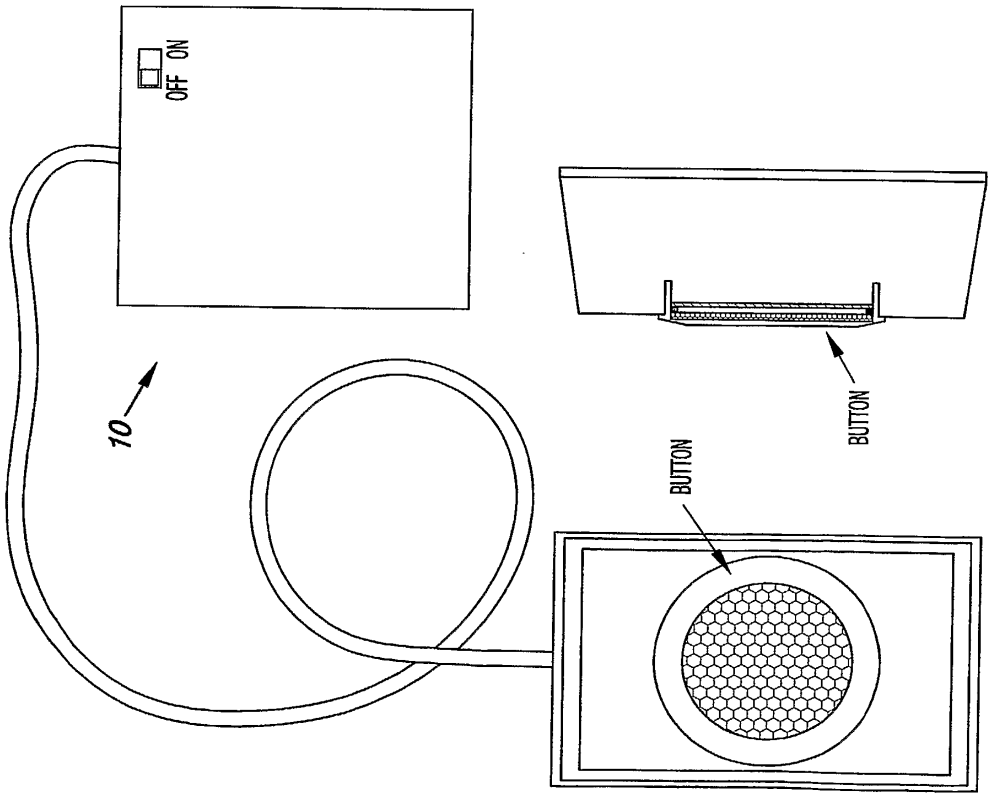
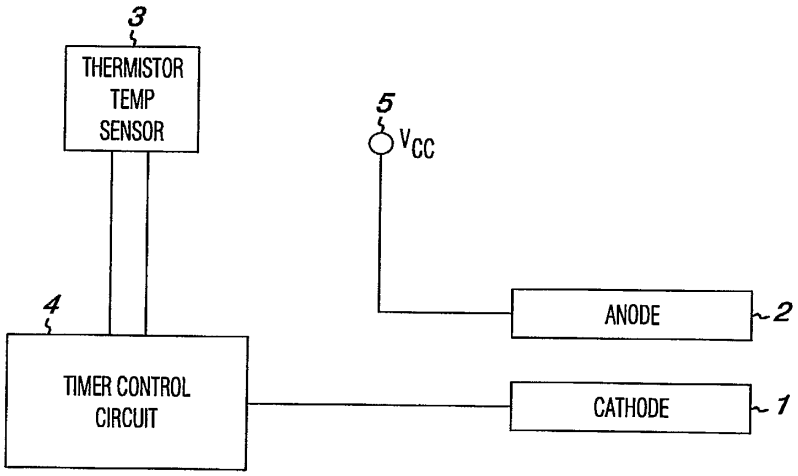


Fig. 2A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THERMISTOR TEMP SENSOR
5
V_{CC}
4
TIMER CONTROL CIRCUIT
ANODE
2
CATHODE
1

Fig. 3

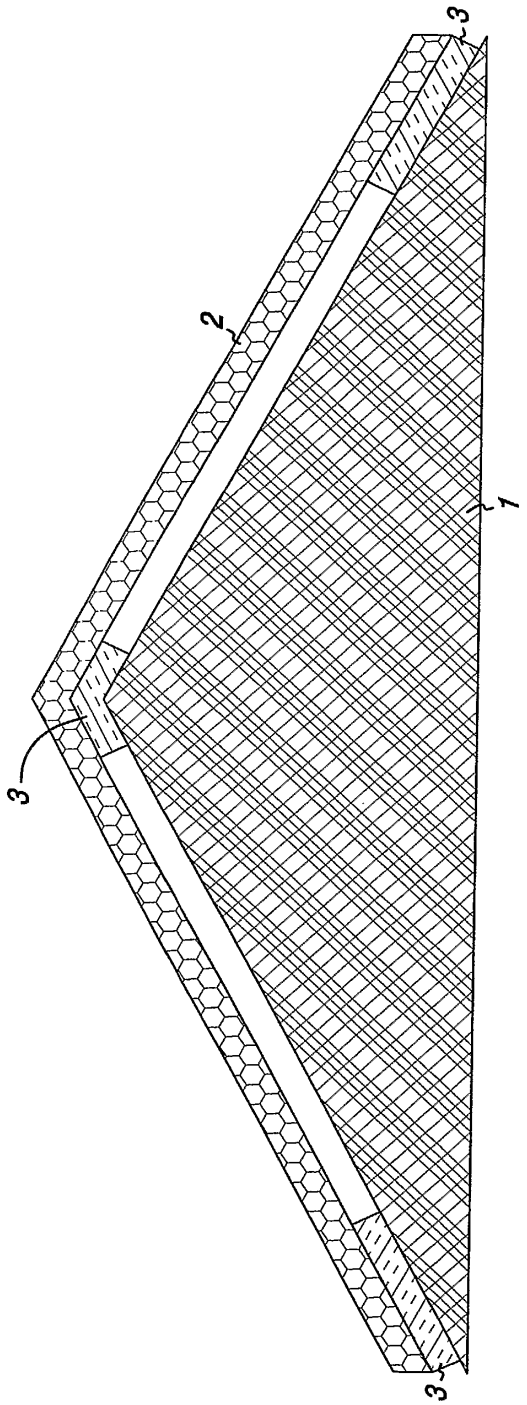

Fig. 4

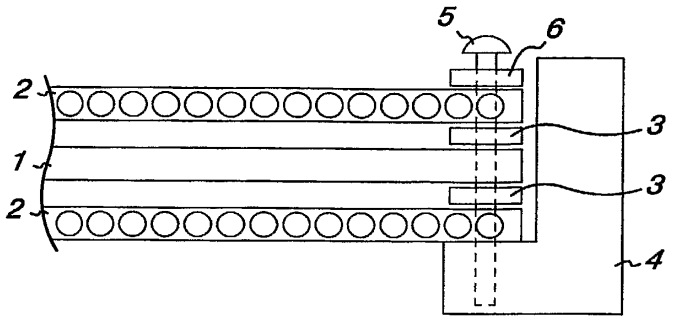

Fig. 5A

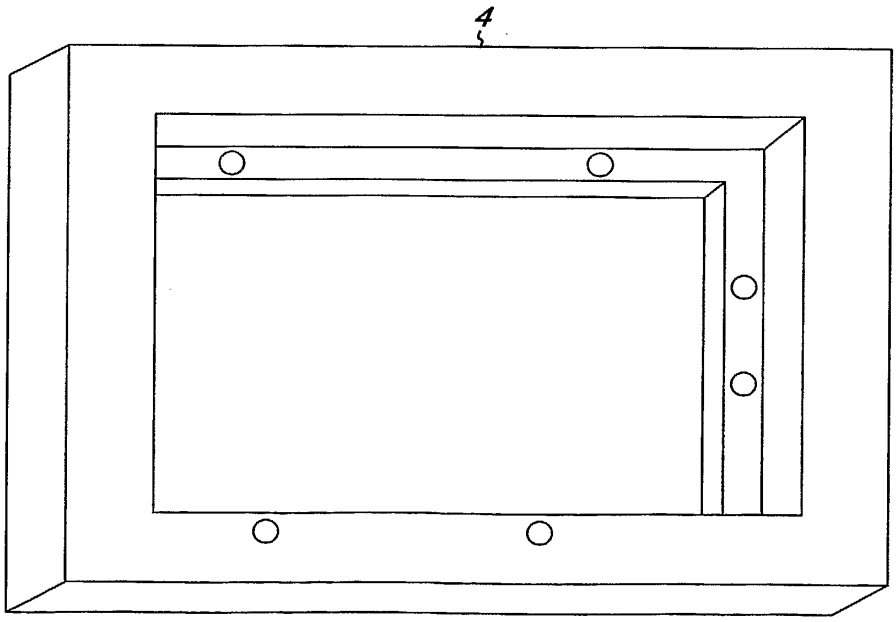

Fig. 5B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/05288

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) :C02F 1/30
US CL :210/748, 758; 204/554, 232, 660
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 210/748, 758; 204/554, 232, 660

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WEST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- A	US 5,993,618 A (SCHULZE et al) 30 November 1999, Fig. 11, col. 5, line 49-col. 6, line 7, abstract, col. 1, lines 4-16.	1-4,7 --- 5,6,8-14
X,P --- A,P	US 6,368,592 B1 (COLTON et al) 09 April 2002, col. 7-8.	1,2,4 --- 3,5-14

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 02 JUNE 2003	Date of mailing of the international search report 11 JUN 2003
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer BETSEY M. HOEY Telephone No. (703) 305-0651

Form PCT/ISA/210 (second sheet) (July 1998)★

Electronic Acknowledgement Receipt	
EFS ID:	2893956
Application Number:	12023431
International Application Number:	
Confirmation Number:	7381
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	24113
Filer:	J. Paul Haun/Valerie Mitchell
Filer Authorized By:	J. Paul Haun
Attorney Docket Number:	4056.02US03
Receipt Date:	21-FEB-2008
Filing Date:	31-JAN-2008
Time Stamp:	17:29:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Filed	4056_02US03_IDS.pdf	132244 9cb80ea2a119916c753c453c1dec02bd93706dda	no	4

Warnings:
Information:

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2	Foreign Reference	4056_02US01_EPSEARCH.pdf	755715 35d60ba736afce768adfdacfce0aafff47062df0	no	3
Warnings:					
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3	Foreign Reference	4056_02_WO09939561A1.pdf	861803 fe50a0449e0b0c9051fa8d6a69e9f543117f5a86	no	21
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Warnings:					
Information:					
		Total Files Size (in bytes):	2975637		

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/023,431	01/31/2008	James Andrew Senkiw	4056.02US03

CONFIRMATION NO. 7381

24113
PATTERSON, THUENTE, SKAAR & CHRISTENSEN, P.A.
4800 IDS CENTER
80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402-2100

FORMALITIES LETTER

OC000000028298647

Date Mailed: 02/15/2008

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
  *Applicant must submit $**75** to complete the basic filing fee for a small entity.*
- The oath or declaration is missing.
  A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.
  Note: If a petition under 37 CFR 1.47 is being filed, an oath or declaration in compliance with 37 CFR 1.63 signed by all available joint inventors, or if no inventor is available by a party with sufficient proprietary interest, is required.

The application is informal since it does not comply with the regulations for the reason(s) indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) are required. The drawings submitted are not acceptable because:
  - The drawings must be reasonably free from erasures and must be free from alterations, overwriting, interlineations, folds, and copy marks. See Figure(s) 7.

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

The applicant needs to satisfy supplemental fees problems indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee or oath or declaration) as set forth in 37 CFR 1.16(f) of $**65** for a small entity in compliance with 37 CFR 1.27, must be submitted with the missing items identified in this notice.

SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is $**500** for a small entity
- $**75** Statutory basic filing fee.
- $**65** Surcharge.
- The application search fee has not been paid. Applicant must submit $**255** to complete the search fee.
- The application examination fee has not been paid. Applicant must submit $**105** to complete the examination fee for a small entity in compliance with 37 CFR 1.27.

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Commissioner for Patents
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Alexandria VA 22313-1450

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For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

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Office of Initial Patent Examination (571) 272-4000 or 1-800-PTO-9199

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/023,431	01/31/2008	1797	0.00	4056.02US03	1	1

CONFIRMATION NO. 7381

24113
PATTERSON, THUENTE, SKAAR & CHRISTENSEN, P.A.
4800 IDS CENTER
80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402-2100

FILING RECEIPT

OC000000028298646

Date Mailed: 02/15/2008

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Filing Receipt Corrections. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

James Andrew Senkiw, Minneapolis, MN;

Assignment For Published Patent Application

AQUA INNOVATIONS, INC., Minnetonka, MN

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a DIV of 10/732,326 12/10/2003
which is a CIP of 10/372,017 02/21/2003 PAT 6,689,262
which claims benefit of 60/358,534 02/22/2002

Foreign Applications

If Required, Foreign Filing License Granted: 02/13/2008

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/023,431**

Projected Publication Date: To Be Determined - pending completion of Missing Parts

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****

Title

FLOW-THROUGH OXYGENATOR

Preliminary Class

210

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

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Title 37, Code of Federal Regulations, 5.11 & 5.15

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PTO/SB/14 (07-07)
Approved for use through 06/30/2010. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	4056.02US03
	Application Number	
Title of Invention	FLOW-THROUGH OXYGENATOR	

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Application Information:

Title of the Invention	FLOW-THROUGH OXYGENATOR		
Attorney Docket Number	4056.02US03	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter			
Suggested Class (if any)		Sub Class (if any)	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	8	Suggested Figure for Publication (if any)	

PTO/SB/14 (07-07)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	4056.02US03
	Application Number	
Title of Invention	FLOW-THROUGH OXYGENATOR	

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☐	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
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Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Division of	10/732326	2003-12-10
Prior Application Status	Patented		Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
10/732326	Continuation in part of	10/372017	2003-02-21	6689262	2004-02-10

Prior Application Status	Expired		Remove
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10/372017	non provisional of	60/358534	2002-02-22

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	4056.02US03
	Application Number	
Title of Invention	FLOW-THROUGH OXYGENATOR	

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Signature	/J. Paul Haun/			Date (YYYY-MM-DD)	2008-01-31
First Name	Paul	Last Name	Haun	Registration Number	53003

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Attorney Docket No. 4056.02US03

FLOW-THROUGH OXYGENATOR

Related Applications

This application is a division of Application No. 10/732,326 filed December 10, 2003, which in turn is a continuation-in-part of Application No. 10/372,017, filed February 21, 2003, now U.S. Patent No. 6,689,262, which claims the benefit of U.S. Provisional Application No. 60/358,534, filed February 22, 2002, each of which is hereby fully incorporated herein by reference.

Field of the Invention

This invention relates to the electrolytic generation of microbubbles of oxygen for increasing the oxygen content of flowing water. This invention also relates to the use of superoxygenated water to enhance the growth and yield of plants. The flow-through model is useful for oxygenating water for hydroponic plant culture, drip irrigation and waste water treatment.

Background of the Invention

Many benefits may be obtained through raising the oxygen content of aqueous media. Efforts have been made to achieve higher saturated or supersaturated oxygen levels for applications such as the improvement of water quality in ponds, lakes, marshes and reservoirs, the detoxification of contaminated water, culture of fish, shrimp and other aquatic animals, biological culture and hydroponic culture. For example, fish held in a limited environment such as an aquarium, a bait bucket or a live hold tank may quickly use up the dissolved oxygen in the

course of normal respiration and are then subject to hypoxic stress, which can lead to death. A similar effect is seen in cell cultures, where the respiring cells would benefit from higher oxygen content of the medium. Organic pollutants from agricultural, municipal and industrial facilities spread through the ground and surface water and adversely affect life forms. Many pollutants are toxic, carcinogenic or mutagenic. Decomposition of these pollutants is facilitated by oxygen, both by direct chemical detoxifying reactions or by stimulating the growth of detoxifying microflora. Contaminated water is described as having an increased biological oxygen demand (BOD) and water treatment is aimed at decreasing the BOD so as to make more oxygen available for fish and other life forms.

The most common method of increasing the oxygen content of a medium is by sparging with air or oxygen. While this is a simple method, the resulting large bubbles produced simply break the surface and are discharged into the atmosphere. Attempts have been made to reduce the size of the bubbles in order to facilitate oxygen transfer by increasing the total surface area of the oxygen bubbles. U.S. Pat. No. 5,534,143 discloses a microbubble generator that achieves a bubble size of about 0.10 millimeters to about 3 millimeters in diameter. U.S. Pat. No. 6,394,429 ("the '429 patent") discloses a device for producing microbubbles, ranging in size from 0.1 to 100 microns in diameter, by forcing air into the fluid at high pressure through a small orifice.

When the object of generating bubbles is to oxygenate the water, either air, with an oxygen content of about 21%, or pure oxygen may be used. The production of oxygen and hydrogen by the electrolysis of water is well known. A current is applied across an anode and a cathode which are immersed in an aqueous medium. The current may be a direct current from a

battery or an AC/DC converter from a line. Hydrogen gas is produced at the cathode and oxygen gas is produced at the anode. The reactions are:

AT THE CATHODE: $4H_2O + 4e^- \rightarrow 4OH^- + 2H_2$

AT THE ANODE: $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$

NET REACTION: $6H_2O \rightarrow 4OH^- + 4H^+ + + 2H_2 + O_2$

286 kilojoules of energy is required to generate one mole of oxygen.

The gasses form bubbles which rise to the surface of the fluid and may be collected. Either the oxygen or the hydrogen may be collected for various uses. The "electrolytic water" surrounding the anode becomes acidic while the electrolytic water surrounding the cathode becomes basic. Therefore, the electrodes tend to foul or pit and have a limited life in these corrosive environments.

Many cathodes and anodes are commercially available. U.S. Pat. No. 5,982,609 discloses cathodes comprising a metal or metallic oxide of at least one metal selected from the group consisting of ruthenium, iridium, nickel, iron, rhodium, rhenium, cobalt, tungsten, manganese, tantalum, molybdenum, lead, titanium, platinum, palladium and osmium. Anodes are formed from the same metallic oxides or metals as cathodes. Electrodes may also be formed from alloys of the above metals or metals and oxides co-deposited on a substrate. The cathode and anodes may be formed on any convenient support in any desired shape or size. It is possible to use the same materials or different materials for both electrodes. The choice is determined according to the uses. Platinum and iron alloys ("stainless steel") are often preferred materials due to their inherent resistance to the corrosive electrolytic water. An especially preferred anode disclosed in U.S. Pat. No. 4,252,856 comprises vacuum deposited iridium oxide.

Holding vessels for live animals generally have a high population of animals which use up the available oxygen rapidly. Pumps to supply oxygen have high power requirements and the noise and bubbling may further stress the animals. The available electrolytic generators likewise have high power requirements and additionally run at high voltages and produce acidic and basic water which are detrimental to live animals. Many of the uses of oxygenators, such as keeping bait or caught fish alive, would benefit from portable devices that did not require a source of high power. The need remains for quiet, portable, low voltage means to oxygenate water.

It has also been known that plant roots are healthier when oxygenated water is applied. It is thought that oxygen inhibits the growth of deleterious fungi. The water sparged with air as in the '429 patent was shown to increase the biomass of hydroponically grown cucumbers and tomatoes by about 15%.

The need remains for oxygenator models suitable to be placed in-line in water distribution devices so as to be applied to field as well as hydroponic culture.

Summary of the Invention

This invention provides an oxygen emitter which is an electrolytic cell which generates very small microbubbles and nanobubbles of oxygen in an aqueous medium, which bubbles are too small to break the surface tension of the medium, resulting in a medium supersaturated with oxygen.

The electrodes may be a metal or oxide of at least one metal selected from the group consisting of ruthenium, iridium, nickel, iron, rhodium, rhenium, cobalt, tungsten, manganese, tantalum, molybdenum, lead, titanium, platinum, palladium and osmium or oxides thereof. The

electrodes may be formed into open grids or may be closed surfaces. The most preferred cathode is a stainless steel mesh. The most preferred mesh is a {fraction (1/16)} inch grid. The most preferred anode is platinum and iridium oxide on a support. A preferred support is titanium.

In order to form microbubbles and nanobubbles, the anode and cathode are separated by a critical distance. The critical distance ranges from 0.005 inches to 0.140 inches. The preferred critical distance is from 0.045 to 0.060 inches.

Models of different size are provided to be applicable to various volumes of aqueous medium to be oxygenated. The public is directed to choose the applicable model based on volume and power requirements of projected use. Those models with low voltage requirements are especially suited to oxygenating water in which animals are to be held.

Controls are provided to regulate the current and timing of electrolysis.

A flow-through model is provided which may be connected in-line to a watering hose or to a hydroponic circulating system. The flow-through model can be formed into a tube with triangular cross-section. In this model, the anode is placed toward the outside of the tube and the cathode is placed on the inside, contacting the water flow. Alternatively, the anodes and cathodes may be in plates parallel to the long axis of the tube, or may be plates in a wafer stack. Alternately, the electrodes may be placed in a side tube ("T" model) out of the direct flow of water. Protocols are provided to produce superoxygenated water at the desired flow rate and at the desired power usage. Controls are inserted to activate electrolysis when water is flowing and deactivate electrolysis at rest.

This invention includes a method to promote growth and increase yield of plants by application of superoxygenated water. The water treated with the emitter of this invention is one example of superoxygenated water. Plants may be grown in hydroponic culture or in soil. The use of the flow-through model for drip irrigation of crops and waste water treatment is disclosed.

Brief Description of the Drawings

FIG. 1 is the O_2 emitter of the invention.

FIG. 2 is an assembled device.

FIG. 3 is a diagram of the electronic controls of the O_2 emitter.

FIG. 4 shows a funnel or pyramid variation of the O_2 emitter.

FIG. 5 shows a multilayer sandwich O_2 emitter.

FIG. 6 shows the yield of tomato plants watered with superoxygenated water.

FIG. 7 shows an oxygenation chamber suitable for flow-through applications. FIG. 7A is a cross section showing arrangement of three plate electrodes. FIG. 7B is a longitudinal section showing the points of connection to the power source.

FIG. 8 is a graph showing the oxygenation of waste water.

Detailed Description of the Invention

Definitions:

For the purpose of describing the present invention, the following terms have these meanings:

"Critical distance" means the distance separating the anode and cathode at which evolved oxygen forms microbubbles and nanobubbles.

"Critical distance" means the distance separating the anode and cathode at which evolved oxygen forms microbubbles and nanobubbles.

"O_2 emitter" means a cell comprised of at least one anode and at least one cathode separated by the critical distance.

"Metal" means a metal or an alloy of one or more metals.

"Microbubble" means a bubble with a diameter less than 50 microns.

"Nanobubble" means a bubble with a diameter less than that necessary to break the surface tension of water. Nanobubbles remain suspended in the water, giving the water an opalescent or milky appearance.

"Supersaturated" means oxygen at a higher concentration than normal calculated oxygen solubility at a particular temperature and pressure.

"Superoxygenated water" means water with an oxygen content at least 120% of that calculated to be saturated at a temperature.

"Water" means any aqueous medium with resistance less than one ohm per square centimeter; that is, a medium that can support the electrolysis of water. In general, the lower limit of resistance for a medium that can support electrolysis is water containing more than 2000 ppm total dissolved solids.

The present invention produces microbubbles and nanobubbles of oxygen via the electrolysis of water. As molecular oxygen radical (atomic weight 8) is produced, it reacts to form molecular oxygen, O_2. In the special dimensions of the invention, as explained in more

detail in the following examples, O_2 forms bubbles which are too small to break the surface tension of the fluid. These bubbles remain suspended indefinitely in the fluid and, when allowed to build up, make the fluid opalescent or milky. Only after several hours do the bubbles begin to coalesce on the sides of the container and the water clears. During that time, the water is supersaturated with oxygen. In contrast, the H_2 formed readily coalesces into larger bubbles which are discharged into the atmosphere, as can be seen by bubble formation at the cathode.

The first objective of this invention was to make an oxygen emitter with low power demands, low voltage and low current for use with live animals. For that reason, a small button emitter was devised. The anode and cathode were set at varying distances. It was found that electrolysis took place at very short distances before arcing of the current occurred. Surprisingly, at slightly larger distances, the water became milky and no bubbles formed at the anode, while hydrogen continued to be bubbled off the cathode. At distance of 0.140 inches between the anode and cathode, it was observed that the oxygen formed bubbles at the anode. Therefore, the critical distance for microbubble and nanobubble formation was determined to be between 0.005 inches and 0.140 inches.

Example 1. Oxygen Emitter.

As shown in FIG. 1, the oxygen evolving anode 1 selected as the most efficient is an iridium oxide coated single sided sheet of platinum on a support of titanium (Eltech, Fairport Harbor, OH). The cathode 2 is a (fraction (1/16)} inch mesh (size 8 mesh) marine stainless steel screen. The anode and cathode are separated by a non-conducting spacer 3 containing a gap 4 for the passage of gas and mixing of anodic and cathodic water and connected to a power source

through a connection point 5. FIG. 2 shows a plan view of the assembled device. The O_2 emitter 6 with the anode connecting wire 7 and the cathode connecting wire 8 is contained in an enclosure 9, connected to the battery compartment 10. The spacer thickness is critical as it sets the critical distance. It must be of sufficient thickness to prevent arcing of the current, but thin enough to separate the electrodes by no more than 0.140 inches. Above that thickness, the power needs are higher and the oxygen bubbles formed at higher voltage will coalesce and escape the fluid. Preferably, the spacer is from 0.005 to 0.075 inches thick. At the lower limits, the emitter tends to foul more quickly. Most preferably, the spacer is about 0.050 inches thick. The spacer may be any nonconductive material such as nylon, fiberglass, Teflon®. polymer or other plastic. Because of the criticality of the space distance, it is preferable to have a non-compressible spacer. It was found that Buna, with a durometer measure of 60 was not acceptable due to decomposition. Viton, a common fluoroelastomer, has a durometer measure of 90 and was found to hold its shape well.

In operation, a small device with an O_2 emitter 1.485 inches in diameter was driven by 4AA batteries. The critical distance was held at 0.050 inches with a Viton spacer. Five gallons of water became saturated in seven minutes. This size is suitable for raising oxygen levels in an aquarium or bait bucket.

It is convenient to attach a control circuit which comprises a timer that is thermostatically controlled by a temperature sensor which determines the off time for the cathode. When the temperature of the solution changes, the resistance of the thermistor changes, which causes an off time of a certain duration. In cool water, the duration is longer so in a given volume, the emitter generates less oxygen. When the water is warmer and therefore hold less oxygen, the duration of

off time is shorter. Thus the device is self-controlled to use power most economically. FIG. 3 shows a block diagram of a timer control with anode 1, cathode 2, thermistor temperature sensor 3, timer control circuit 4 and wire from a direct current power source 5.

Example 2. Measurement of O_2 Bubbles.

Attempts were made to measure the diameter of the O_2 bubbles emitted by the device of Example 1. In the case of particles other than gasses, measurements can easily be made by scanning electron microscopy, but gasses do not survive electron microscopy. Large bubble may be measured by pore exclusion, for example, which is also not feasible when measuring a gas bubble. A black and white digital, high contrast, backlit photograph of treated water with a millimeter scale reference was shot of water produced by the emitter of Example 1. About 125 bubbles were seen in the area selected for measurement. Seven bubbles ranging from the smallest clearly seen to the largest were measured. The area was enlarged, giving a scale multiplier of 0.029412.

Recorded bubble diameters at scale were 0.16, 0.22, 0.35, 0.51, 0.76, 0.88 and 1.09 millimeters. The last three were considered outliers by reverse analysis of variance and were assumed to be hydrogen bubbles. When multiplied by the scale multiplier, the assumed O_2 bubbles were found to range from 4.7 to 15 microns in diameter. This test was limited by the resolution of the camera and smaller bubbles in the nanometer range could not be resolved. It is known that white light cannot resolve features in the nanometer size range, so monochromatic laser light may give resolution sensitive enough to measure smaller bubbles. Efforts continue to increase the sensitivity of measurement so that sub-micron diameter bubbles can be measured.

Example 3. Other Models of Oxygen Emitter.

Depending on the volume of fluid to be oxygenated, the oxygen emitter of this invention may be shaped as a circle, rectangle, cone or other model. One or more may be set in a substrate that may be metal, glass, plastic or other material. The substrate is not critical as long as the current is isolated to the electrodes by the nonconductor spacer material of a thickness from 0.005 to 0.075 inches, preferably 0.050 inches. It has been noticed that the flow of water seems to be at the periphery of the emitter, while the evolved visible bubbles (H_2) arise at the center of the emitter. Therefore, a funnel or pyramidal shaped emitter was constructed to treat larger volumes of fluid. FIG. 4 is a cross sectional diagram of such an emitter. The anode 1 is formed as an open grid separated from a marine grade stainless steel screen cathode 2 by the critical distance by spacer 3 around the periphery of the emitter and at the apex. This flow-through embodiment is suitable for treating large volumes of water rapidly.

The size may be varied as required. A round emitter for oxygenating a bait bucket may be about 2 inches in diameter, while a 3-inch diameter emitter is adequate for oxygenating a 10 to 40 gallon tank. The live well of a fishing boat will generally hold 40 to 80 gallons of water and require a 4-inch diameter emitter. It is within the scope of this invention to construct larger emitters or to use several in a series to oxygenate larger volumes. It is also within the scope of this invention to vary the model to provide for low voltage and amperage in cases where the need for oxygen is moderate and long lasting or conversely, to supersaturate water very quickly at higher voltage and amperage. In the special dimensions of the present invention, it has been found that a 6 volt battery supplying a current as low as 40 milliamperes is sufficient to generate

oxygen. Such a model is especially useful with live plants or animals, while it is more convenient for industrial use to use a higher voltage and current. Table I shows a number of models suitable to various uses.

TABLE I

Emitter Model	Gallons	Volts	Amps Max.	Ave	Watts
Bait keeper	5	6	0.090	0.060	0.36
Livewell	32	12	0.180	0.120	1.44
OEM 2 inch	10	12	0.210	0.120	1.44
Bait store	70	12	0.180	0.180	2.16
Double cycle	2	12	0.180	0.180	2.16
OEM 3 inch	50	12	0.500	0.265	3.48
OEM 4 inch	80	12	0.980	0.410	4.92
Water pail	2	24	1.200	1.200	28.80
Plate	250	12	5.000	2.500	30.00

Example 4..Multilayer Sandwich O_2 Emitter.

An O_2 emitter was made in a multilayer sandwich embodiment. (FIG. 5) An iridium oxide coated platinum anode 1 was formed into a grid to allow good water flow and sandwiched between two stainless steel screen cathodes 2. Spacing was held at the critical distance by nylon spacers 3. The embodiment illustrated is held in a cassette 4 which is secured by nylon bolt 5 with a nylon washer 6. The dimensions selected were:

cathode screen	0.045 inches thick
nylon spacer	0.053 inches thick
anode grid	0.035 inches thick
nylon spacer	0.053 inches thick
cathode screen	0.045 inches thick,

for an overall emitter thickness of 0.231 inches thick inches.

If a more powerful emitter is desired, it is within the scope of this invention to repeat the sequence of stacking. For example, an embodiment may easily be constructed with this sequence: cathode, spacer, anode, spacer, cathode, spacer, anode, spacer, cathode, spacer, anode, spacer, cathode. The number of layers in the sandwich is limited only by the power requirements acceptable for an application.

Example 5. Effect of Superoxygenated Water on the Growth of Plants.

It is known that oxygen is important for the growth of plants. Although plants evolve oxygen during photosynthesis, they also have a requirement for oxygen for respiration. Oxygen is evolved in the leaves of the plants, while often the roots are in a hypoxic environment without enough oxygen to support optimum respiration, which can be reflected in less than optimum growth and nutrient utilization. Hydroponically grown plants are particularly susceptible to oxygen deficit in the root system. U.S. Pat. No. 5,887,383 describes a liquid supply pump unit for hydroponic cultures which attain oxygen enrichment by sparging with air. Such a method has high energy requirements and is noisy. Furthermore, while suitable for self-contained hydroponic culture, the apparatus is not usable for field irrigation. In a report available on the

web, it was shown that hydroponically grown cucumbers and tomatoes supplied with water oxygenated with a device similar to that described in the '429 patent had increased biomass of about 12% and 17% respectively. It should be noted that when sparged with air, the water may become saturated with oxygen, but it is unlikely that the water is superoxygenated.

A. Superoxygenated Water in Hydroponic Culture.

Two small hydroponic systems were set up to grow two tomato plants. Circulation protocols were identical except that the 21/2 gallon water reservoir for the Control plant was eroated with and aquarium bubbler and that for the Test plant was oxygenated with a five-inch strip emitter for two minutes prior to pumping. The cycle was set at four minutes of pumping, followed by four minutes of rest. The control water had an oxygen content of about 97% to 103% saturation, that is, it was saturated with oxygen. The test water had an oxygen content of about 153% to 165% saturation, that is, it was supersaturated. The test plant was at least four times the volume of the control plant and began to show what looked like fertilizer burn. At that point the fertilizer for the Test plant was reduced by half. Since the plants were not exposed to natural light but to continuous artificial light in an indoor environment without the natural means of fertilization (wind and/or insects), the experiment was discontinued after three months. At that time, the Test plant but not the Control plant had blossomed.

B. Superoxygenated Water in Field Culture.

A pilot study was designed to ascertain that plants outside the hydroponic culture facility would benefit from the application of oxygen. It was decided to use water treated with the

emitter of Example 1 as the oxygen carrier. Since water so treated is supersaturated, it is an excellent carrier of oxygen.

Tomato seeds (Burpee "Big Boy") were planted in one-inch diameter peat and dirt plugs encased in cheese cloth and placed in a tray in a southwest window. Controls were watered once a day with tap water ("Control") or oxygenated water ("Test"). Both Controls and Test sprouted at one week. After five weeks, the Test plants were an average of 11 inches tall while the Controls were an average of nine inches tall. At this time, May 10, when the threat of frost in Minnesota was minimal, the plants were transplanted to 13 inch diameter pots with drainage holes. Four inches of top soil was added to each pot, topped off with four inches of Scott's Potting Soil. The pots were placed outside in a sunny area with at least eight hours a day of full sun. The plants were watered as needed with either plain tap water (Control) or oxygenated water (Test). The oxygenated water was produced by use of the emitter of Example 1 run for one-half hour in a five-gallon container of water. Previous experiments showed that water thus treated had an oxygen content from 160% to 260% saturation. The Test plants flowered on June 4, while the Controls did not flower until June 18. For both groups, every plant in the group first had flowers on the same day. All plants were fertilized on July 2 and a soaker hose provided because the plants were now so big that watering by hand was difficult. The soaker hose was run for one half to one hour each morning, depending on the weather, to a point at which the soil was saturated with water. One half hour after the soaker hose was turned off, about 750 ml of superoxygenated water was applied to each of the Test plants.

The Test plants were bushier than the Controls although the heights were similar. At this time, there were eight Control plants and seven Test plants because one of the Test plants broke

in a storm. On July 2, the control plants averaged about 17 primary branches from the vine stem, while the control plants averaged about 13 primary branches from the vine stem. As the tomatoes matured, each was weighed on a kitchen scale at harvest. The yield history is shown in Table II.

TABLE II

Week of:	Control, grams tomatoes from eight plants/cumulative total		Test, grams tomatoes from seven plants/cumulative total	
July 27	240		400	
August 3	180	420	2910	3310
August 10	905	1325	1830	5140
August 17	410	1735	2590	7730
August 24	3300	5035	2470	10200
August 31	4150	9175	1580	11780
September 15	not weighed		3710	15490
Final Harvest September 24	6435	15620	8895	24385

The total yield for the eight Control plants was 15620 grams or 1952 grams of tomatoes per plant.

The total yield for the seven Test plants was 24385 grams or 3484 grams of tomatoes per plant, an increase in yield of about 79% over the Control plants.

FIG. 6 shows the cumulative total as plotted against time. Not only did the Test plants blossom and bear fruit earlier, but that the Control plants never caught up to the test plants in the

short Minnesota growing season. It should be noted that the experiment was terminated because of predicted frost. All fruits, both green and red, were harvested and weighed at that point.

Example 6. Flow-through Emitter for Agricultural Use.

In order to apply the findings of example 5 to agricultural uses, an emitter than can oxygenate running water efficiently was developed. In FIG. 7(A), the oxygenation chamber is comprised of three anodes 1 and cathodes 2, of appropriate size to fit inside a tube or hose and separated by the critical distance are placed within a tube or hose 3 at 120° angles to each other. The anodes and cathodes are positioned with stabilizing hardware 4. The stabilizing hardware, which can be any configuration such as a screw, rod or washer, is preferably formed from stainless steel. FIG. 7(B) shows a plan view of the oxygenation chamber with stabilizing hardware 4 serving as a connector to the power source and stabilizing hardware 5 serving as a connector to the power source. The active area is shown at 6.

This invention is not limited to the design selected for this embodiment. Those skilled in the art can readily fabricate any of the emitters shown in FIG. 4 or 5, or can design other embodiments that will oxygenate flowing water. One useful embodiment is the "T" model, wherein the emitter unit is set in a side arm. The emitted bubbles are swept into the water flow. The unit is detachable for easy servicing. Table III shows several models of flow through emitters. The voltage and flowrates were held constant and the current varied. The Dissolved oxygen (DO) from the source was 7.1 mg/liter. The starting temperature was 12.2°C. but the flowing water cooled slightly to 11 or 11.5°C. Without undue experimentation, anyone may

easily select the embodiment that best suits desired characteristics from Table III or designed with the teachings of Table III.

TABLE III

MODEL	ACTIVE ELECTRODE AREA, SQ.IN.	VOLTAGE	CURRENT, AMPS.	FLOW RATE GAL/MINUTE	DO OF* SAMPLE AT ONE MINUTE
2-Inch "T"	2	28.3	0.72	12	N/A
3-inch "T"	3	28.3	1.75	12	N/A
2-plate Tube	20	28.3	9.1	12	8.4
3-Plate tube	30	28.3	12.8	12	9.6

*As the apparatus runs longer, the flowing water becomes milky, indicating supersaturation. The one-minute time point shows the rapid increase in oxygenation.

The following plants will be tested for response to superoxygenated water: grape vines, lettuce, and radishes in three different climate zones. The operators for these facilities will be supplied with units for drip irrigation. Drip irrigation is a technique wherein water is pumped through a pipe or hose with perforations at the site of each plant to be irrigated. The conduit may be underground or above ground. Since the water is applied directly to the plant rather than wetting the entire field, this technique is especially useful in arid climates or for plants requiring high fertilizer applications.

The superoxygenated water will be applied by drip irrigation per the usual protocol for the respective plants. Growth and yield will be compared to the same plants given only the usual

irrigation water. Pest control and fertilization will be the same between test and control plants, except that the operators of the experiments will be cautioned to be aware of the possibility of fertilizer burn in the test plants and to adjust their protocols accordingly.

It is expected that the superoxygenated plants with drip irrigation will show more improved performance with more continuous application of oxygen than did the tomato plants of Example 5, which were given superoxygenated water only once a day.

Example 7. Treatment of Waste Water.

Waste water, with a high organic content, has a high BOD, due to the bacterial flora. It is desirable to raise the oxygen content of the waste water in order to cause the flora to flocculate. However, it is very difficult to effectively oxygenate such water. Using a 4 inch OEM (see Table I) with a 12 volt battery, four liters of waste water in a five gallon pail were oxygenated. As shown in FIG. 8, the dissolved oxygen went from 0.5 mg/l to 10.8 mg/l in nine minutes.

Those skilled in the art will readily comprehend that variations, modifications and additions may in the embodiments described herein may be made. Therefore, such variations, modifications and additions are within the scope of the appended claims.

CLAIMS

1. A method for treating waste water comprising;

providing a flow-through oxygenator comprising an emitter for electrolytic generation of microbubbles of oxygen comprising an anode separated at a critical distance from a cathode and a power source all in electrical communication with each other,

placing the emitter within a conduit; and

passing waste water through the conduit.

ABSTRACT

An oxygen emitter which is an electrolytic cell is disclosed. When the anode and cathode are separated by a critical distance, very small microbubbles and nanobubbles of oxygen are generated. The very small oxygen bubbles remain in suspension, forming a solution supersaturated in oxygen. A flow-through model for oxygenating flowing water is disclosed. The use of supersaturated water for enhancing the growth of plants is disclosed. Methods for applying supersaturated water to plants manually, by drip irrigation or in hydroponic culture are described. The treatment of waste water by raising the dissolved oxygen with the use of an oxygen emitter is disclosed.

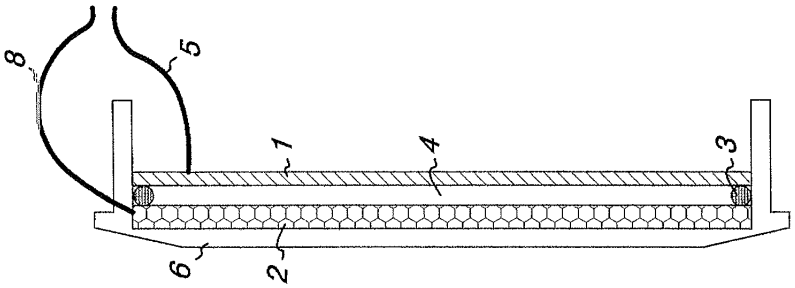


Fig. 1B

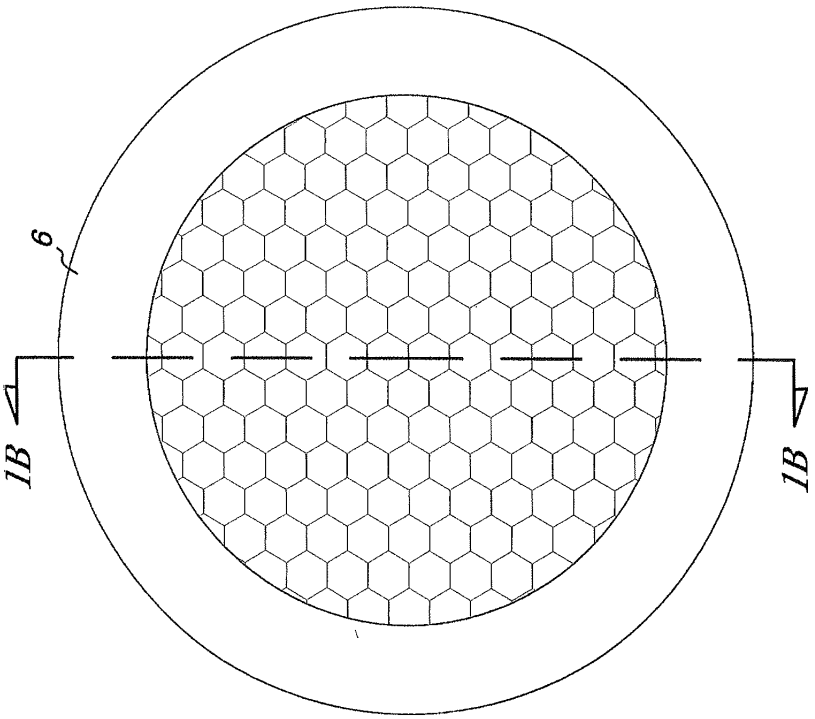


Fig. 1A

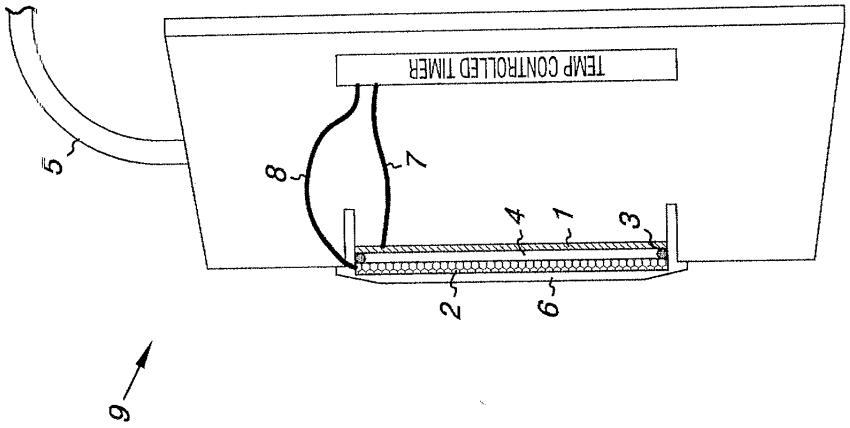


Fig. 2B

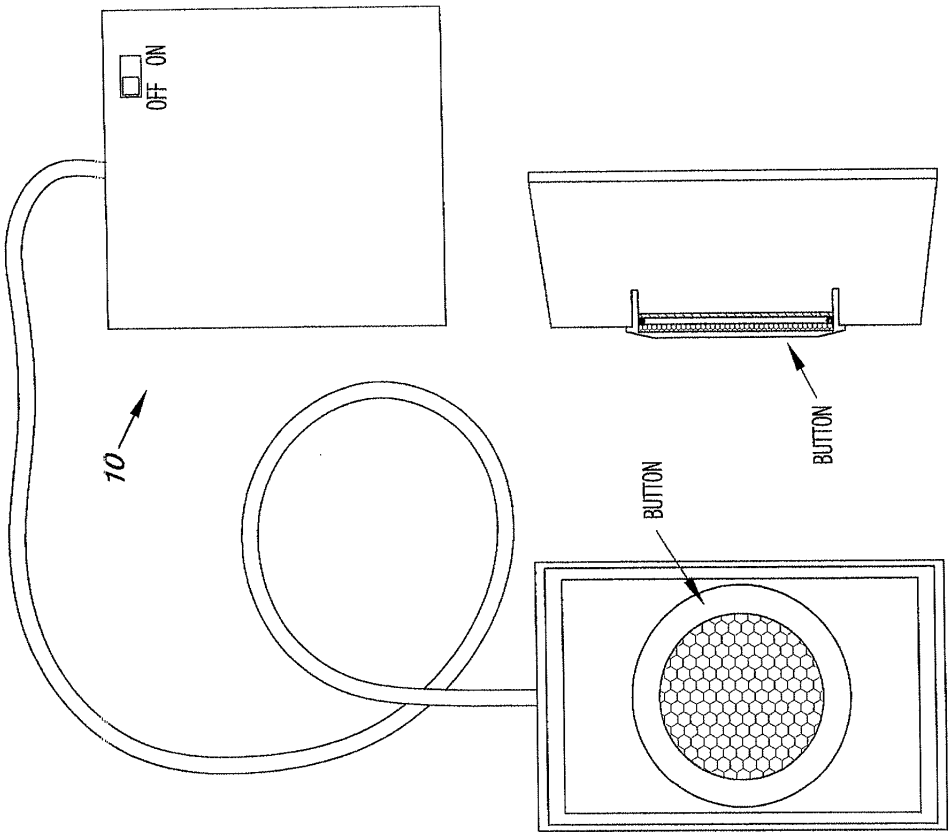


Fig. 2A

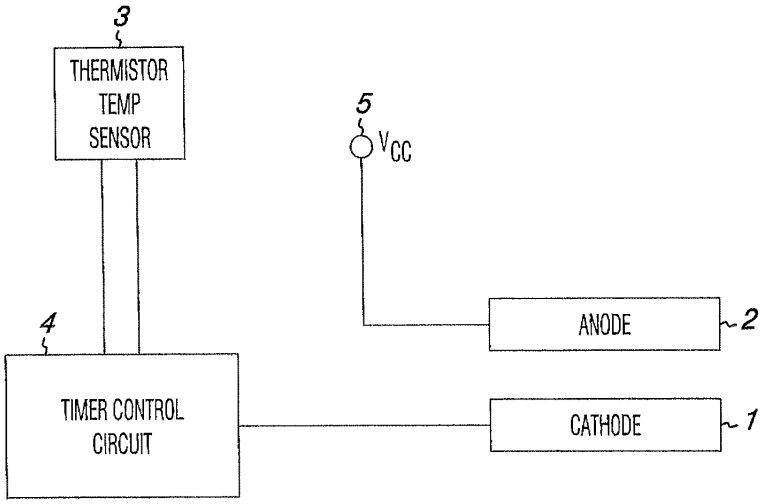

3
THERMISTOR
TEMP
SENSOR
5
V_{CC}
4
TIMER CONTROL
CIRCUIT
ANODE
2
CATHODE
1

Fig. 3

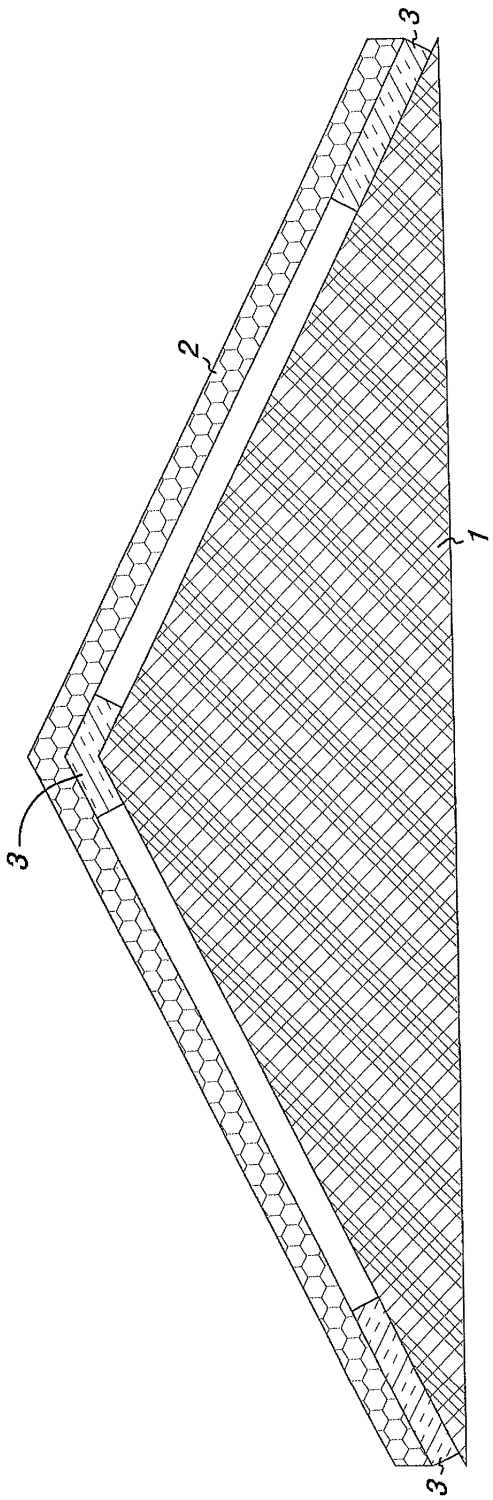


Fig. 4

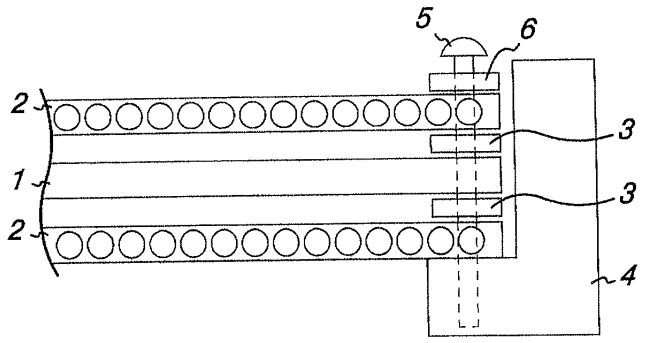


Fig. 5A

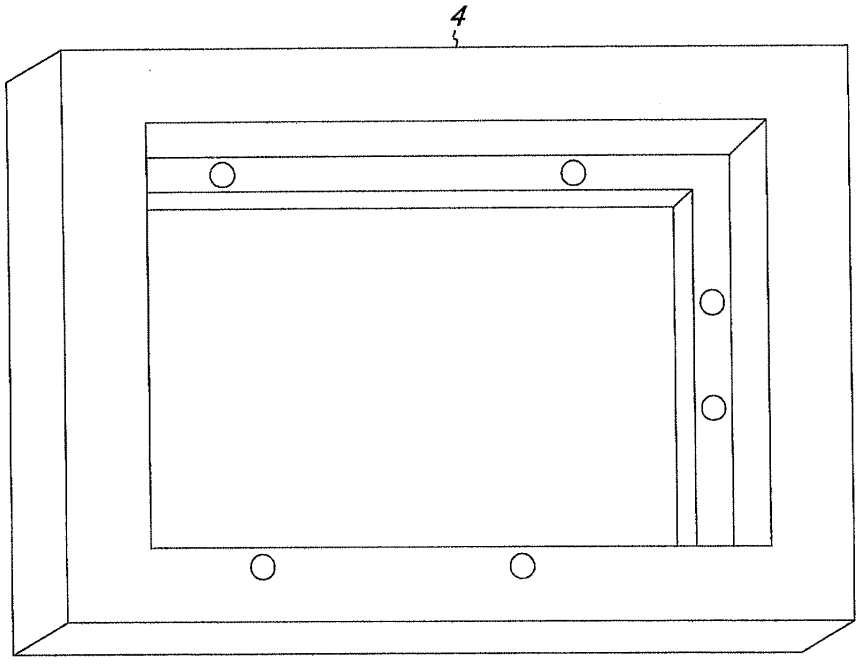


Fig. 5B

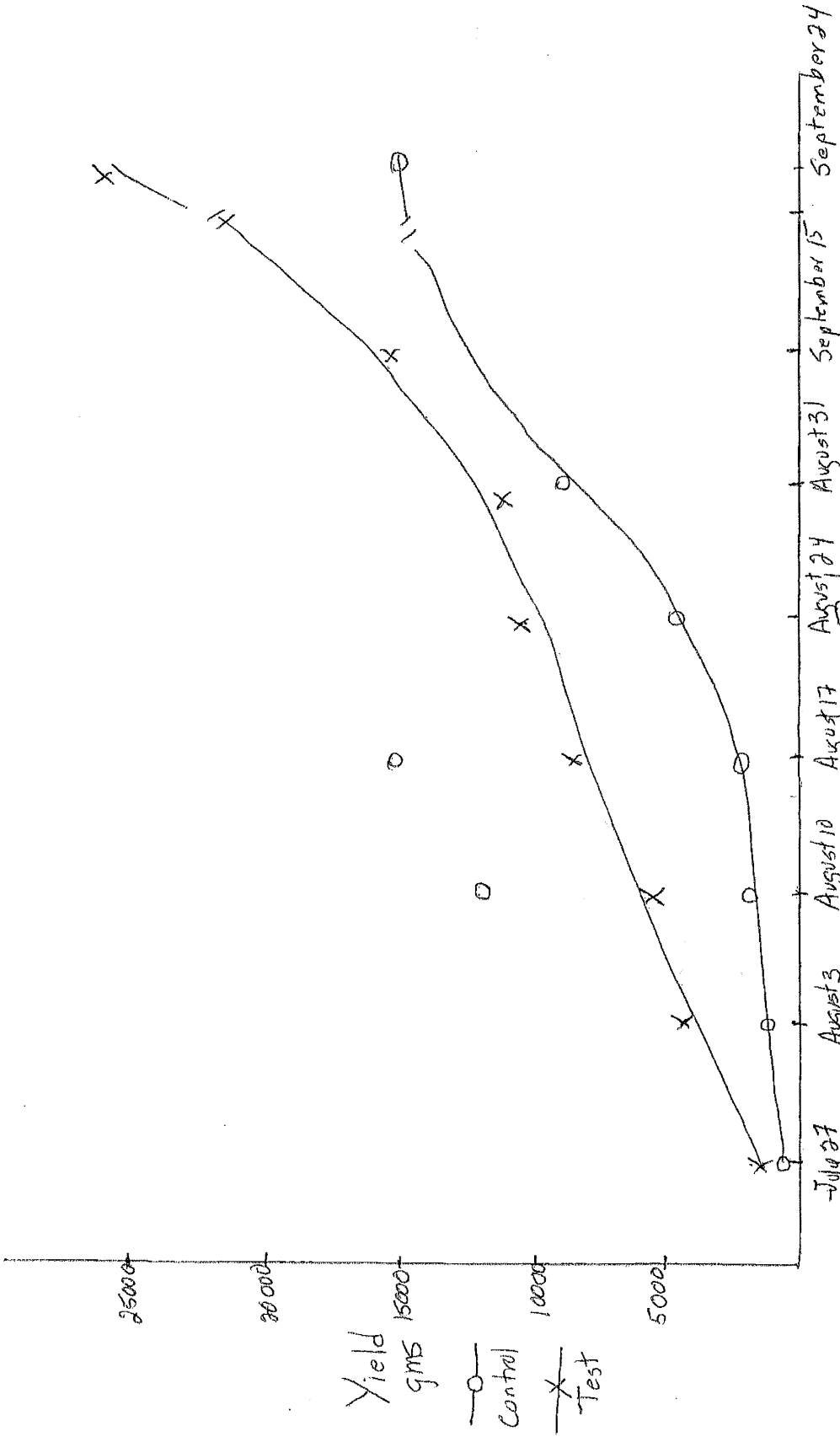
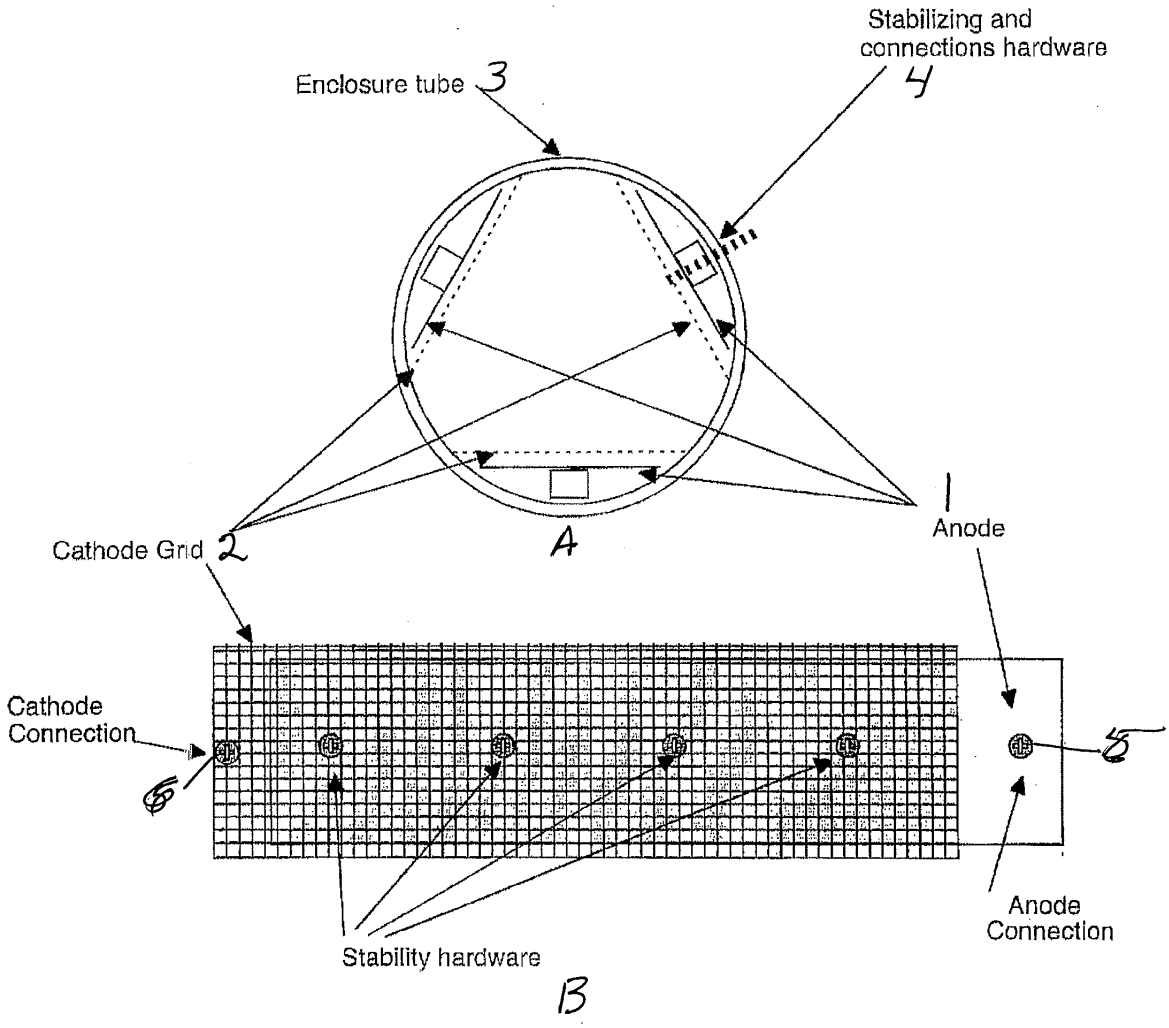

25000
20000
15000
10000
5000
Yield
gms
Control
Test
July 27
August 3
August 10
August 17
August 24
August 31
September 7
September 14
Date

Figure 4

3 Element Flow Through Oxygenation Chamber



~~Depending on requirements tube can contain 1 2 3 4 or more elements.~~

Figure 7

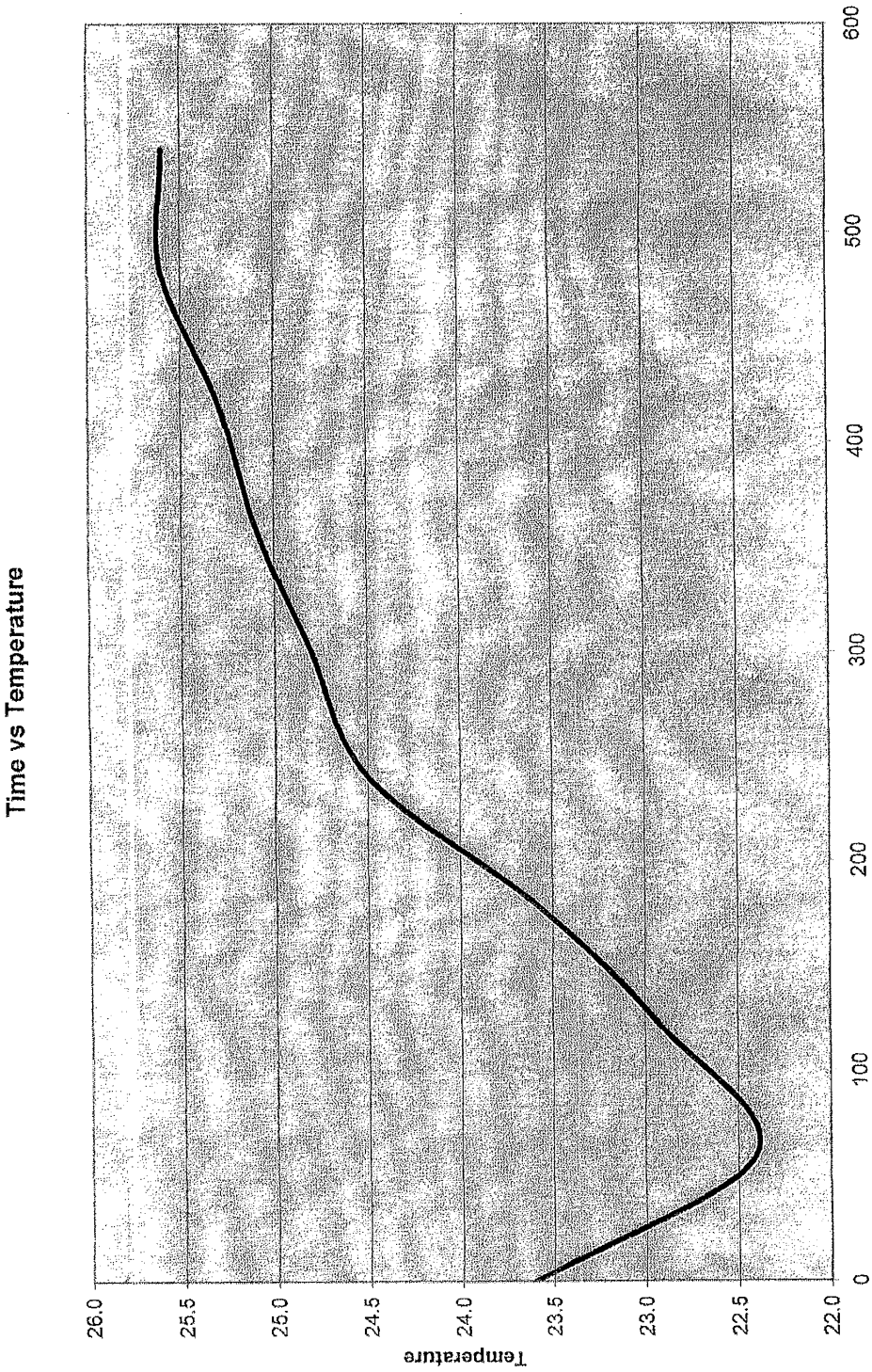


Figure 8

Electronic Acknowledgement Receipt	
EFS ID:	2795920
Application Number:	12023431
International Application Number:	
Confirmation Number:	7381
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	24113
Filer:	J. Paul Haun/Valerie Mitchell
Filer Authorized By:	J. Paul Haun
Attorney Docket Number:	4056.02US03
Receipt Date:	31-JAN-2008
Filing Date:	
Time Stamp:	15:07:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	4056_02US03_ADS.pdf	1036181 7274f19404ba911ea1800e759b6adb8ef809bb55	no	4
Warnings:					
Information:					

2		4056_02US03_APP.pdf	1348099 a43da8d3790dbd60fc0f95656d30f3db9aa7e818	yes	29

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Specification	1	19
Claims	20	20
Abstract	21	21
Drawings-only black and white line drawings	22	29

Warnings:	
Information:	
Total Files Size (in bytes):	2384280

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (12-04)

Filing Date: **01/31/08**

Approved for use through 7/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

12/023,431

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY		OR	OTHER THAN	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	255		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	105		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	1 (25)	0	X$ 25	0	OR	X$50	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1	* 0	X$105	0		X$210	
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))			185			370	
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	435		TOTAL	0

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDI-TIONAL FEE ($)		RATE ($)	ADDI-TIONAL FEE ($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					N/A		OR	N/A	
						TOTAL ADD'T FEE		OR	TOTAL ADD'T FEE	

		(Column 1)		(Column 2)	(Column 3)			OR		
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDI-TIONAL FEE ($)		RATE ($)	ADDI-TIONAL FEE ($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					N/A		OR	N/A	
						TOTAL ADD'T FEE		OR	TOTAL ADD'T FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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JA980

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Reissue Patent Application of:
Title: FLOW-THROUGH OXYGENATOR
Attorney Docket No.: 3406.005USR
Customer No.: 21186

REISSUE PATENT APPLICATION TRANSMITTAL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items and information (as indicated with an "X"):

X **Utility - REIS comprising:**
- X Reissue Patent Application Transmittal (PTO/SB/50) (1 pg.)
- X Specification (6 pgs, including claims numbered 1 through 49 and a 1 page Abstract).
- X Drawing(s) (8 sheets).
- X Copy of Certificate of Correction (1 pg.).
- X Signed Reissue Declaration (3 pgs).
- X Signed Power of Attorney (1 pg), Statement Under 37 C.F.R. § 3.73(b)(2 pgs.), Evidence of Ownership (4 pgs).
- X Consent of Assignee of Security Interest to Reissue (6 pgs.).
- X Consent of Assignee to Reissue (6 pgs.).
- X Authorization to charge Deposit Account 19-0743 in the amount of $2700.00 to pay the filing fee.

X Preliminary Amendment (17 pgs.).
X Applicant claims small entity status under 37 CFR 1.27.

The filing fee has been calculated below as follows:

	No. Filed	No. Extra	Rate	Fee
TOTAL CLAIMS	65- 20	45	x $30.00 =	**$1350.00**
INDEPENDENT CLAIMS	5 - 3	2	x $125.00 =	**$250.00**
[X]MULTIPLE DEPENDENT CLAIMS PRESENTED				**$225.00**
BASIC FEE				**$190.00**
SEARCH FEE				**$310.00**
EXAMINATION FEE				**$375.00**
	No. of pages (75% for e-filing)	**Extra sets of 50 pages**	**Rate**	
APPLICATION SIZE FEE	(11 - 100) / 50	0	$155.00	**$0.00**
TOTAL				**$2700.00**

Please charge any additional required fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
Customer Number: 21186

/ By: Albin J. Nelson /
Albin J. Nelson
Reg. No. 28,650

Date of Deposit: September 28, 2011
This paper or fee is being filed on the date indicated above using the USPTO's electronic filing system EFS-Web, and is addressed to The Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

PTO/SB/50 (08-08)
Approved for use through 08/31/2010. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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REISSUE PATENT APPLICATION TRANSMITTAL

Address to:

Mail Stop Reissue
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Attorney Docket No.	3406.005USR
First Named Inventor	James Andrew Senkiw
Original Patent Number	7,670,495
Original Patent Issue Date (Month/Day/Year)	March 2, 2010
Express Mail Label No.	Submitted via EFS Web

APPLICATION FOR REISSUE OF: (*Check applicable box*) [X] Utility Patent [ ] Design Patent [ ] Plant Patent

APPLICATION ELEMENTS (37 CFR 1.173)

1. [ ] Fee Transmittal Form (PTO/SB/56)
2. [ ] Applicant claims small entity status. See 37 CFR 1.27.
3. [X] Specification and Claims in double column copy of patent format *(amended, if appropriate)*
4. [X] Drawing(s) *(proposed amendments, if appropriate)*
5. [X] Reissue Oath/Declaration (original or copy) (37 C.F.R. 1.175) (PTO/SB/51 or 52)
6. [X] Power of Attorney
7. [X] Original U.S. Patent currently assigned? [X] Yes [ ] No *(If Yes, check applicable box(es))*
   - [X] Written Consent of all Assignees (PTO/SB/53)
   - [X] 37 CFR 3.73(b) Statement (PTO/SB/96)
8. [ ] CD-ROM or CD-R in duplicate, Computer Program (Appendix) or large table
   - [ ] Landscape Table on CD
9. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, items a. – c. are required))*
   - a. [ ] Computer Readable Form (CRF)
   - b. Specification Sequence Listing on:
     - i [ ] CD-ROM (2 copies) or CD-R (2 copies); **or**
     - ii [ ] paper
   - c. [ ] Statements verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

10. [ ] Statement of status and support for all changes to the claims. See 37 CFR 1.173(c).
11. [ ] Foreign Priority Claim (35 U.S.C. 119) *(if applicable)*
12. [ ] Information Disclosure Statement (IDS) PTO/SB/08 or PTO-1449
    - [ ] Copies of foreign patent documents, publications & other information
13. [ ] English Translation of Reissue Oath/Declaration *(if applicable)*
14. [X] Preliminary Amendment
15. [ ] Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
16. [ ] Other:

17. CORRESPONDENCE ADDRESS

[X] The address associated with *Customer Number:* 21186 **OR** [ ] *Correspondence address below*

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	
Signature				Date	28 Sept 2011
Name (Print/Type)	Albin James Nelson			Registration No. (Attorney/Agent)	28,650

This collection of information is required by 37 CFR 1.173. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop Reissue, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Attorney Docket No.3406.005USR

SCHWEGMAN ■ LUNDBERG ■ WOESSNER

United States Patent Application

REISSUE DECLARATION OF INVENTORSHIP

As a below named inventor I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that

I believe I am the original, first and sole inventor of the subject matter which is described and claimed in U.S. Patent No. **7,670,495** which was issued on **March 2, 2010** and of the subject matter claimed in the broadening reissue patent application Filed Herewith, which reissue patent application corresponds to U.S. Patent No. **7,670,495** the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by the preliminary amendment filed herewith.

I acknowledge the duty to disclose information which is material to the patentability of this reissue application in accordance with 37 C.F.R. § 1.56 (attached hereto).

I state pursuant to 37 C.F.R §1.175(a) that I, the Applicant, believe the original patent to be partly inoperative or invalid by reason of the patentee claiming less than the patentee had a right to claim in the patent. I believe that the errors to be relied upon as the basis for reissue are to be found in the text of the claims of the patent in that they do not encompass the full scope of Applicant's invention and unnecessarily limit that scope. For example, Applicant was entitled to claim but did not claim such aspects of the disclosed invention as the construction of the emitter as a flow though device with one or more sets of electrodes therein and an arrangement of the sets of electrodes that would provide a relative relationship of those sets at angles other than 120°. In addition, Applicant was entitled to claim but did not claim the full range of the separation distance between the electrodes of the emitter. Furthermore, Applicant was entitled to claim but did not claim additional aspects of the disclosed invention such as a tube shape for the emitter, a grid design for the electrodes, an arrangement of the electrodes within the tube shaped emitter which placed one kind of electrode inside the other kind, and methods for cleaning waste and filth. In addition, the original patent presents claims that are limited by features that Applicant was entitled to omit. Those features include the recitation in those original claims of the specific dimensions of the microbubbles of oxygen. Applicant was entitled to claim but did not claim microbubbles that would not break the surface tension of the water but without specifying the dimensions of those microbubbles. These and additional errors are addressed and corrected by the new independent and dependent claims presented by the preliminary amendment submitted herewith.

Applicant acknowledges that the full range for the separation distance is recited by some of the dependent claims of parent U.S. Patent No's. 7,396,441 and 6,689,262, that a flow through device as a flow through oxygenator is recited by the claims of parent U.S. Patent No. 7,396,441, and that the recitation of the dimensions of microbubbles is omitted from at least some of the independent claims of these parent patents. However, the claims of these parent patents do not recite the same subject matter and features set forth in either the original claims of U.S. Patent No. 7,670,495 or the subject matter Applicant was entitled to claim but did not claim as described in the foregoing paragraph. Therefore, the subject matter of the claims presented by the preliminary amendment submitted with this Declaration has not heretofore been examined by the U.S. Patent and Trademark Office, nor has it been claimed as such by U.S. Patent No. 7,670,495 or by the parent patents.

The examples provided herein are not intended to be exhaustive or exclusive, but are presented for stating at least one error being relied upon as the basis for reissue pursuant to 37 C.F.R. 1.175. Additional errors are addressed and corrected as presented by the preliminary amendment filed herewith.

I state that all errors present in the original patent and in the present reissue application up to the time of filing of this Reissue Declaration, and errors which are addressed and corrected by the preliminary amendment concurrently filed with this Reissue Declaration, which correction of errors I have reviewed, arose without any deceptive intention on the part of the Applicant.

I understand that pursuant to 37 C.F.R. §3.71, the assignee, Oxygenator Water Technologies, Inc., has granted the power of attorney, for prosecuting this reissue patent application and for transacting all related business, to attorneys and agents of the firm of Schwegman, Lundberg, & Woessner, P. A., **Customer Number 21186**. I confirm and agree with this appointment.

Please direct all correspondence and all communications to **Schwegman, Lundberg & Woessner, P.A.,** at the address provided by the following customer number.

Customer Number: 21186

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of James Andrew Senkiw
Citizenship: U.S.A
Residence: Minneapolis, MN
Post Office Address: 4750 Aldrich Ave N, Minneapolis MN 55430-3529

Signature: _____ Date: 22 Sept 2011
James Andrew Senkiw

§ 1.56 Duty to disclose information material to patentability.

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application:

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

MODIFIED PTO/SB/80 (11-08)
Approved for use through 11/30/2011. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the Patents identified in the attached statement under 37 CFR 3.73(b).

I hereby appoint:

☒ Practitioners associated with the Customer Number: **21186**

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used.

Name	Registration Number		Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications , patents and reissue patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) to:

☒ The address associated with Customer Number: **21186**

OR

☐ Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address:
Oxygenator Water Technologies
6101 Baker road, suite 206
Minnetonka Minnesota 55345.
United States of America

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record
The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	Mark Rolfes	Date: 09-22-2017
Name	Mark Rolfes	Telephone:
Title	President	

Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

S/N Filed Herewith **REISSUE PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	James Andrew Senkiw.	Examiner: Unknown
Serial No.:	Filed Herewith	Group Art Unit: Unknown
Filed:	Filed Herewith	Atty. Docket No.: 3406.005US1
Reissue of U.S. Patent No. 7,670,495		Issued March 2, 2010
Title: FLOW-THROUGH OXYGENATOR		Customer Number: 44367

STATEMENT OF PATENTS, PATENT APPLICATIONS AND REISSUE PATENT APPLICATION PURSUANT TO 37 C.F.R. §3,73(b)

Mail Stop Reissue
Commissioner for Patents
P.O. Box 1450
Alexandria , VA 22313-1450

Oxygenator Water Technologies as the sole assignee of the following U.S. Patents and Reissue patent applications names practitioners associated with Customer Number 21186 as attorneys or agents to represent Oxygenator Water Technologies before the U.S. Patent and Trademark office and to transact all business in connection therewith.

Designated U.S. Patents and Patent Application
U.S Patent No. 6,689,262
U.S. Patent No.7,396,441
U.S. Patent No. 7,670,495
Reissue application of U.S. Patent No. 7,670,495 filed herewith

Oxygenator Water Technologies states that its right to assert its status as sole assignee of the above-identified U.S. Patent No. 7,670,495 and the corresponding reissue application is shown by the assignment records recorded at 020546/0241 showing the assignment of the sole inventor to Aqua Innovations Inc.; at 021354/0676 showing the assignment of Aqua Innovations Inc. to Oxygenator Water Technologies, Inc. D/B/A water D.O.G. Works. The security interest indicated by record 026079/0823 is not an assignment of ownership but rather is a security interest in and to the designated patent.

Oxygenator Water Technologies states that its right to assert its status as sole assignee of the above-identified U.S. Patent No. 7,396,441is shown by the assignment records recorded at 017998/0954 showing the assignment of the sole inventor to Aqua Innovations Inc.; at 020480/0246 showing the assignment of Aqua Innovations Inc. to Oxygenator Water Technologies, Inc. D/B/A water D.O.G. Works. The security interest indicated by record 021354/0676 is not an assignment of ownership but rather is a security interest in and to the designated patent.

Oxygenator Water Technologies states that its right to assert its status as sole assignee of the above-identified U.S. Patent No. 6,689,262 and the corresponding reissue application is shown by the assignment records recorded at 019690/0523 showing the assignment of the sole inventor to Aqua Innovations Inc.; at 021354/676 showing the assignment of Aqua Innovations Inc. to Oxygenator Water Technologies, Inc. D/B/A water D.O.G. Works. The security interest indicated by record 026079/0823 is not an assignment of ownership but rather is a security interest in and to the designated patent.

Oxygenator Water Technologies states that its right to assert its status as sole assignee of the above-identified Reissue Patent Application stems from its ownership of the U.S. Patent on which the Reissue Patent Application is based, namely, U.S. Patent No. 7,670,495.

The Patent Assignment Abstract of Title for each of the above-identified U.S. Patents is attached to this statement under 37 C.F.R. §3.74(b).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Mark Rolfes
President, Oxygenator Water Technologies

09-22-2011
Date

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Patent Assignment Details

NOTE:Results display only for issued patents and published applications. For pending or abandoned applications please consult USPTO staff.

Reel/Frame: 020546/0241 **Pages:** 6

Recorded: 02/22/2008

Attorney Dkt #: 4056.02US02/03

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Total properties: 2

1 **Patent #:** NONE **Issue Dt:** **Application #:** 12023416 **Filing Dt:** 01/31/2008
Publication #: US20080202995 **Pub Dt:** 08/28/2008
Title: FLOW-THROUGH OXYGENATOR

2 **Patent #:** 7670495 **Issue Dt:** 03/02/2010 **Application #:** 12023431 **Filing Dt:** 01/31/2008
Publication #: US20080179259 **Pub Dt:** 07/31/2008
Title: FLOW-THROUGH OXYGENATOR

Assignor

1 SENKIW, JAMES ANDREW **Exec Dt:** 05/25/2006

Assignee

1 AQUA INNOVATIONS, INC.
6101 BAKER ROAD
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Correspondence name and address

J. PAUL HAUN
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Reel/Frame: 021354/0676 **Pages:** 6

Recorded: 08/11/2008

Attorney Dkt #: 4056.00-00-01

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Total properties: 7

1 **Patent #:** 6689262 **Issue Dt:** 02/10/2004 **Application #:** 10372017 **Filing Dt:** 02/21/2003
Publication #: US20030164306 **Pub Dt:** 09/04/2003
Title: MICROBUBBLES OF OXYGEN

2 **Patent #:** 7396441 **Issue Dt:** 07/08/2008 **Application #:** 10732326 **Filing Dt:** 12/10/2003
Publication #: US20040118701 **Pub Dt:** 06/24/2004
Title: FLOW-THROUGH OXYGENATOR

3 **Patent #:** NONE **Issue Dt:** **Application #:** 11367134 **Filing Dt:** 03/04/2006
Publication #: US20060150491 **Pub Dt:** 07/13/2006
Title: Flow-through oxygenator

4 **Patent #:** NONE **Issue Dt:** **Application #:** 11810540 **Filing Dt:** 06/06/2007
Publication #: US20070284245 **Pub Dt:** 12/13/2007
Title: Water treatment system

5 **Patent #:** NONE **Issue Dt:** **Application #:** 12023416 **Filing Dt:** 01/31/2008
Publication #: US20080202995 **Pub Dt:** 08/28/2008
Title: FLOW-THROUGH OXYGENATOR

6 **Patent #:** 7670495 **Issue Dt:** 03/02/2010 **Application #:** 12023431 **Filing Dt:** 01/31/2008
Publication #: US20080179259 **Pub Dt:** 07/31/2008
Title: FLOW-THROUGH OXYGENATOR

7 **Patent #:** NONE **Issue Dt:** **Application #:** 12055723 **Filing Dt:** 03/26/2008
Publication #: US20080237060 **Pub Dt:** 10/02/2008
Title: METHODS AND APPARATUS FOR ELECTROLYTIC TREATMENT OF WATER

Assignor

1 AQUA INNOVATIONS, INC. **Exec Dt:** 08/08/2008

Assignee

1 OXYGENATOR WATER TECHNOLOGIES, INC. D/B/A WATER D.O.G. WORKS
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Correspondence name and address

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MINNEAPOLIS, MN 55402

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Reel/Frame: 026079/0823 **Pages:** 10

Recorded: 02/09/2011

Conveyance: PROMISSORY NOTES GRANTING SECURITY INT

Total properties: 3

1	**Patent #:** 6689262	**Issue Dt:** 02/10/2004	**Application #:** 10372017	**Filing Dt:** 02/21/2003	
	Publication #: US20030164306	**Pub Dt:** 09/04/2003			
	Title: MICROBUBBLES OF OXYGEN				
2	**Patent #:** 7396441	**Issue Dt:** 07/08/2008	**Application #:** 10732326	**Filing Dt:** 12/10/2003	
	Publication #: US20040118701	**Pub Dt:** 06/24/2004			
	Title: FLOW-THROUGH OXYGENATOR				
3	**Patent #:** 7670495	**Issue Dt:** 03/02/2010	**Application #:** 12023431	**Filing Dt:** 01/31/2008	
	Publication #: US20080179259	**Pub Dt:** 07/31/2008			
	Title: FLOW-THROUGH OXYGENATOR				

Assignors

1 OXYGENATOR WATER TECHNOLOGIES, INC. **Exec Dt:** 09/09/2008

2 WATER D.O.G. WORKS **Exec Dt:** 10/24/2008

Assignee

1 BRINK, JEFFREY P.
2003 SUGAR WOODS DRIVE
ORONO, MINNESOTA USA 55356

Correspondence name and address

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MINNEAPOLIS, MN 55402

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Web interface last modified: July 25, 2011 v.2.2

S/N Filed Herewith **REISSUE PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	James Andrew Senkiw.	Examiner: Unknown
Serial No.:	Filed Herewith	Group Art Unit: Unknown
Filed:	Filed Herewith	Atty. Docket No.: 3406.005US1
Reissue of U.S. Patent No. 7,670,495		Issued March 2, 2010
Title: FLOW-THROUGH OXYGENATOR		Customer Number: 44367

CONSENT BY ASSIGNEE OF SECURITY INTEREST TO FILE REISSUE APPLICATION OF U.S. PATENT NO. 7,670,495 PURSUANT TO 37 C.F.R. §1.172

Mail Stop Reissue
Commissioner for Patents
P.O. Box 1450
Alexandria , VA 22313-1450

I, Jeffrey P. Brink, declare that:

1. I am the same Jeffrey P. Brink identified on recorded assignment document reel and frame number 026079/0823 of the Patent Assignment, Abstract of Title recordation department of the U.S. Patent and Trademark Office as holding a promissory note security interest in and to U.S. Patent No. 7,670,495.

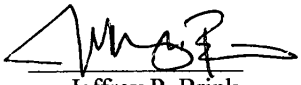
2. I further state that I received the above-described security interest from the Assignee of record of all right, title and interest, Oxygenator Water Technologies, Inc, D/B/A Water D.O.G. Works and that this Assignee received its assignment of all right, title and interest according to the chain of title transfer from the inventor, Mr. James Andrew Senkiw to Aqua Innovations, Inc. and hence from Aqua Innovations, Inc. to Oxygenator Water Technologies, Inc as shown by the assignment documents recorded respectively at reel and frame numbers 020546/0241 and 021354/0676 of the Patent Assignment, Abstract of Title recordation department of the U.S. Patent and Trademark Office.

3. I understand that the owner and assignee of U.S. Patent No. 7,670,495, Oxygenator Water Technologies, Inc., has requested herewith a broadening reissue of U.S. Patent No. 7,670,495.

4. Pursuant to 37 C.F.R. §1.172 and as an Assignee of a security interest in and to this patent, I state that I consent to the filing of the re-issue application of U.S. Patent No. 7,670,495 and to the enlargement of the claimed subject matter as presented by the preliminary amendment filed herewith.

5. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

6. Further Declarant sayeth not.



Jeffrey P. Brink
Declarant

9/12/11
Date

United States Patent and Trademark Office

Assignments on the Web > Patent Query

Patent Assignment Details

NOTE:Results display only for issued patents and published applications. For pending or abandoned applications please consult USPTO staff.

Reel/Frame: 020546/0241 **Pages:** 6

Recorded: 02/22/2008

Attorney Dkt #: 4056.02US02/03

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Total properties: 2

1 **Patent #:** NONE **Issue Dt:** **Application #:** 12023416 **Filing Dt:** 01/31/2008
Publication #: US20080202995 **Pub Dt:** 08/28/2008
Title: FLOW-THROUGH OXYGENATOR

2 **Patent #:** 7670495 **Issue Dt:** 03/02/2010 **Application #:** 12023431 **Filing Dt:** 01/31/2008
Publication #: US20080179259 **Pub Dt:** 07/31/2008
Title: FLOW-THROUGH OXYGENATOR

Assignor

1 SENKIW, JAMES ANDREW **Exec Dt:** 05/25/2006

Assignee

1 AQUA INNOVATIONS, INC.
6101 BAKER ROAD
MINNETONKA, MINNESOTA 55345

Correspondence name and address

J. PAUL HAUN
4800 IDS CENTER, 80 SOUTH 8TH STREET
MINNEAPOLIS, MN 55402

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Patent Assignment Details

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Reel/Frame: 021354/0676 **Pages:** 6

Recorded: 08/11/2008

Attorney Dkt #: 4056.00-00-01

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Total properties: 7

1 **Patent #:** 6689262 **Issue Dt:** 02/10/2004 **Application #:** 10372017 **Filing Dt:** 02/21/2003
Publication #: US20030164306 **Pub Dt:** 09/04/2003
Title: MICROBUBBLES OF OXYGEN

2 **Patent #:** 7396441 **Issue Dt:** 07/08/2008 **Application #:** 10732326 **Filing Dt:** 12/10/2003
Publication #: US20040118701 **Pub Dt:** 06/24/2004
Title: FLOW-THROUGH OXYGENATOR

3 **Patent #:** NONE **Issue Dt:** **Application #:** 11367134 **Filing Dt:** 03/04/2006
Publication #: US20060150491 **Pub Dt:** 07/13/2006
Title: Flow-through oxygenator

4 **Patent #:** NONE **Issue Dt:** **Application #:** 11810540 **Filing Dt:** 06/06/2007
Publication #: US20070284245 **Pub Dt:** 12/13/2007
Title: Water treatment system

5 **Patent #:** NONE **Issue Dt:** **Application #:** 12023416 **Filing Dt:** 01/31/2008
Publication #: US20080202995 **Pub Dt:** 08/28/2008
Title: FLOW-THROUGH OXYGENATOR

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Publication #: US20080179259 **Pub Dt:** 07/31/2008
Title: FLOW-THROUGH OXYGENATOR

7 **Patent #:** NONE **Issue Dt:** **Application #:** 12055723 **Filing Dt:** 03/26/2008
Publication #: US20080237060 **Pub Dt:** 10/02/2008
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Assignor

1 AQUA INNOVATIONS, INC. **Exec Dt:** 08/08/2008

Assignee

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Web interface last modified: July 25, 2011 v.2.2

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Patent Assignment Details

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Reel/Frame: 026079/0823 **Pages:** 10

Recorded: 02/09/2011

Conveyance: PROMISSORY NOTES GRANTING SECURITY INT

Total properties: 3

1	**Patent #:** 6689262	**Issue Dt:** 02/10/2004	**Application #:** 10372017	**Filing Dt:** 02/21/2003
	Publication #: US20030164306	**Pub Dt:** 09/04/2003		
	Title: MICROBUBBLES OF OXYGEN			
2	**Patent #:** 7396441	**Issue Dt:** 07/08/2008	**Application #:** 10732326	**Filing Dt:** 12/10/2003
	Publication #: US20040118701	**Pub Dt:** 06/24/2004		
	Title: FLOW-THROUGH OXYGENATOR			
3	**Patent #:** 7670495	**Issue Dt:** 03/02/2010	**Application #:** 12023431	**Filing Dt:** 01/31/2008
	Publication #: US20080179259	**Pub Dt:** 07/31/2008		
	Title: FLOW-THROUGH OXYGENATOR			

Assignors

1	OXYGENATOR WATER TECHNOLOGIES, INC.	**Exec Dt:** 09/09/2008
2	WATER D.O.G. WORKS	**Exec Dt:** 10/24/2008

Assignee

1 BRINK, JEFFREY P.
2003 SUGAR WOODS DRIVE
ORONO, MINNESOTA USA 55356

Correspondence name and address

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901 MARQUETTE AVENUE
MINNEAPOLIS, MN 55402

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Web interface last modified: July 25, 2011 v.2.2

S/N Filed Herewith **REISSUE PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	James Andrew Senkiw.	Examiner: Unknown
Serial No.:	Filed Herewith	Group Art Unit: Unknown
Filed:	Filed Herewith	Atty. Docket No.: 3406.005US1
Reissue of U.S. Patent No. 7,670,495		Issued March 2, 2010
Title: FLOW-THROUGH OXYGENATOR		Customer Number: 44367

CONSENT BY ASSIGNEE OF ENTIRE OWNERSHIP INTEREST TO FILE REISSUE APPLICATION OF U.S. PATENT NO. 7,670,495 PURSUANT TO 37 C.F.R. §1.172

Mail Stop Reissue
Commissioner for Patents
P.O. Box 1450
Alexandria , VA 22313-1450

I, Mark Rolfes, declare that:

1. I am the president of Oxygenator Water Technologies, Inc D/B/A Water D.O.G Works identified on recorded assignment document reel and frame number 026079/0823 of the Patent Assignment, Abstract of Title recordation department of the U.S. Patent and Trademark Office as holding all right, title and interest in and to U.S. Patent No. 7,670,495 subject to the security interest held by Jeffery P. Brink as recorded at assignment document reel and frame number 026079/0823.

2. I further state that Oxygenator Water Technologies, Inc, D/B/A Water D.O.G. Works received its assignment of all right, title and interest according to the chain of title transfer from the inventor, Mr. James Andrew Senkiw to Aqua Innovations, Inc. and hence from Aqua Innovations, Inc. to Oxygenator Water Technologies, Inc as shown by the assignment documents recorded respectively at reel and frame numbers 020546/0241 and 021354/0676 of the Patent Assignment, Abstract of Title recordation department of the U.S. Patent and Trademark Office.

3. As president and officer of Oxygenator Water Technologies, Inc., I have caused Oxygenator Water Technologies Inc. to request herewith a broadening reissue of U.S. Patent No. 7,670,495.

4. Pursuant to 37 C.F.R. §1.172 and as an Assignee of all right, title and interest in and to U.S. Patent No. 7,670,495, subject to the security interest to Jeffery P. Brink, I state on behalf of Oxygenator Water Technologies, Inc. that Oxygenator Water Technologies, Inc.

consents to the filing of the re-issue application of U.S. Patent No. 7,670,495 and to the enlargement of the claimed subject matter as presented by the preliminary amendment filed herewith.

5. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

6. Further Declarant sayeth not.

Mark Rolfes

09-22-2011

Mark Rolfes
President, Oxygenator Water Technologies
DBA Water D.O.G. Works

Date

United States Patent and Trademark Office

Assignments on the Web > Patent Query

Patent Assignment Details

NOTE:Results display only for issued patents and published applications. For pending or abandoned applications please consult USPTO staff.

Reel/Frame: 020546/0241 **Pages:** 6

Recorded: 02/22/2008

Attorney Dkt #: 4056.02US02/03

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Total properties: 2

1 **Patent #:** NONE **Issue Dt:** **Application #:** 12023416 **Filing Dt:** 01/31/2008
Publication #: US20080202995 **Pub Dt:** 08/28/2008
Title: FLOW-THROUGH OXYGENATOR

2 **Patent #:** 7670495 **Issue Dt:** 03/02/2010 **Application #:** 12023431 **Filing Dt:** 01/31/2008
Publication #: US20080179259 **Pub Dt:** 07/31/2008
Title: FLOW-THROUGH OXYGENATOR

Assignor

1 SENKIW, JAMES ANDREW **Exec Dt:** 05/25/2006

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Web interface last modified: July 25, 2011 v.2.2

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Patent Assignment Details

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Reel/Frame: 021354/0676 **Pages:** 6

Recorded: 08/11/2008

Attorney Dkt #: 4056.00-00-01

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Total properties: 7

1 **Patent #:** 6689262 **Issue Dt:** 02/10/2004 **Application #:** 10372017 **Filing Dt:** 02/21/2003
Publication #: US20030164306 **Pub Dt:** 09/04/2003
Title: MICROBUBBLES OF OXYGEN

2 **Patent #:** 7396441 **Issue Dt:** 07/08/2008 **Application #:** 10732326 **Filing Dt:** 12/10/2003
Publication #: US20040118701 **Pub Dt:** 06/24/2004
Title: FLOW-THROUGH OXYGENATOR

3 **Patent #:** NONE **Issue Dt:** **Application #:** 11367134 **Filing Dt:** 03/04/2006
Publication #: US20060150491 **Pub Dt:** 07/13/2006
Title: Flow-through oxygenator

4 **Patent #:** NONE **Issue Dt:** **Application #:** 11810540 **Filing Dt:** 06/06/2007
Publication #: US20070284245 **Pub Dt:** 12/13/2007
Title: Water treatment system

5 **Patent #:** NONE **Issue Dt:** **Application #:** 12023416 **Filing Dt:** 01/31/2008
Publication #: US20080202995 **Pub Dt:** 08/28/2008
Title: FLOW-THROUGH OXYGENATOR

6 **Patent #:** 7670495 **Issue Dt:** 03/02/2010 **Application #:** 12023431 **Filing Dt:** 01/31/2008
Publication #: US20080179259 **Pub Dt:** 07/31/2008
Title: FLOW-THROUGH OXYGENATOR

7 **Patent #:** NONE **Issue Dt:** **Application #:** 12055723 **Filing Dt:** 03/26/2008
Publication #: US20080237060 **Pub Dt:** 10/02/2008
Title: METHODS AND APPARATUS FOR ELECTROLYTIC TREATMENT OF WATER

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Patent Assignment Details

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Reel/Frame: 026079/0823 **Pages:** 10

Recorded: 02/09/2011

Conveyance: PROMISSORY NOTES GRANTING SECURITY INT

Total properties: 3

1	**Patent #:** 6689262	**Issue Dt:** 02/10/2004	**Application #:** 10372017	**Filing Dt:** 02/21/2003	
	Publication #: US20030164306	**Pub Dt:** 09/04/2003			
	Title: MICROBUBBLES OF OXYGEN				
2	**Patent #:** 7396441	**Issue Dt:** 07/08/2008	**Application #:** 10732326	**Filing Dt:** 12/10/2003	
	Publication #: US20040118701	**Pub Dt:** 06/24/2004			
	Title: FLOW-THROUGH OXYGENATOR				
3	**Patent #:** 7670495	**Issue Dt:** 03/02/2010	**Application #:** 12023431	**Filing Dt:** 01/31/2008	
	Publication #: US20080179259	**Pub Dt:** 07/31/2008			
	Title: FLOW-THROUGH OXYGENATOR				

Assignors

1 OXYGENATOR WATER TECHNOLOGIES, INC. **Exec Dt:** 09/09/2008

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Web interface last modified: July 25, 2011 v.2.2

S/N Filed Herewith **REISSUE PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	James Andrew Senkiw.	Examiner: Unknown
Serial No.:	Unknown	Group Art Unit: Unknown
Filed:	Filed Herewith	Atty. Docket No.: 3406.005USR
Reissue of U.S. Patent No. 7,670,495		Issued March 2, 2010
Title: FLOW-THROUGH OXYGENATOR		Customer Number: 44367

PRELIMINARY AMENDMENT FOR REISSUE APPLICATION OF U.S. PATENT NO. 7,670,495 PURSUANT TO 37 C.F.R. §1.173(b)

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Prior to examination of the above identified reissue patent application, please enter the following preliminary amendment of the claims:

IN THE CLAIMS

Please amend the claims as follows:

Please amend claim 2 as follows.

2. (Amended) An emitter for electrolytic generation of microbubbles of oxygen in an aqueous medium comprising: an anode separated at a critical distance from a cathode, a nonconductive spacer maintaining the separation of the anode and cathode,[the nonconductive spacer having a spacer thickness between 0.005 and 0.050 inches] such that the critical distance is from 0.005 inches to 0.140 inches [less than 0.060 inches] and a power source all in electrical communication with each other wherein the critical distance results in the formation of oxygen microbubbles [bubbles] having a bubble diameter of less than 0.0006 inches, said oxygen microbubbles [bubbles] being incapable of breaking the surface tension of the aqueous medium [such that said aqueous medium is supersaturated with oxygen].

Please add the following new claims.

13. An emitter suitable for producing microbubbles and nanobubbles of oxygen in an aqueous medium or liquid water, comprising:

a flow though device with an inlet end, an outlet end and a long axis measured from the inlet to outlet ends,

the device containing at least one anode electrode and at least one cathode electrode, both of a grid design, the electrodes having long axes which are parallel to the long axis of the device, and

the electrodes being separated by a distance of less than about 0.140 inches.

14. An emitter according to claim 13 wherein the flow through device is shaped as a conduit and the conduit has inlet and outlet ends and the long axis, and contains the electrodes.

15. An emitter according to claim 13 wherein the flow through device is shaped as a tube and the tube has inlet and outlet ends and the long axis and contains the electrodes.

16. An emitter according to claim 13, 14 or 15 wherein the electrodes are separated by a nonconductive spacer.

17. An emitter according to claim 13, 14 or 15 wherein the electrodes are separated by a nonconductive spacer and a distance of from about 0.005 inches to about 0.140 inches.

18. An emitter according to claim 17 wherein the electrodes are separated by a nonconductive spacer and a distance of less than about 0.060 inches.

19. An emitter according to claim 13, 14 or 15 wherein the flow through device, conduit or tube has an inner wall, the at least one anode is an anode set, the at least one cathode is a cathode set and the arrangement of the electrodes places one of the anode set and the cathode set next to the inner wall and the other set inside the set next to the inner wall.

20. An emitter according to claim 19 wherein the anode and cathode sets have a concentric arrangement.

21. An emitter according to claim 13, 14 or 15 wherein the electrodes are composed of a metal or metal oxide or a combination thereof.

22. An emitter according to claim 13, 14 or 15 wherein a multiple number of anode and cathode electrodes are present.

23. An emitter according to claim 22 wherein the flow through device, conduit or tube has an inner wall, the multiple number of anodes is an anode set, the multiple number of cathodes is a cathode set, the arrangement of the sets of electrodes places one set next to the inner wall and the

other set inside the set next to the inner wall.

24. An emitter according to claim 23 wherein each electrode of each set of electrodes has a width such that each set of electrodes approximates a cylinder.

25. An emitter according to claim 24 wherein the cylinders have a concentric arrangement.

26. An emitter according to claim 13, 14 or 15 further comprising a power source electrically connected to the anode and cathode.

27. An emitter according to claim 26 further comprising a liquid water source flowably connected to the inlet of the flow through device, conduit or tube.

28. An emitter according to claim 27 further comprising a control circuit to selectively couple the power source to the electrodes when water flows through the device, conduit or tube.

29. An emitter according to claim 28, wherein when liquid water flows through the emitter and a current is applied to the electrodes by the power source, the emitter operates to produce microbubbles and nanobubbles of oxygen in the liquid water and the microbubbles and nanobubbles are substantially incapable of breaking the surface tension of the water.

30. A system suitable for producing microbubbles and nanobubbles of oxygen in liquid water or an aqueous medium, comprising:

a flow though device with an inlet end, an outlet end and a long axis measured from the inlet to outlet ends,

the device containing at least one anode electrode and at least one cathode electrode, both of a grid design, the electrodes having long axes which are parallel to the long axis of the flow through device, and

the electrodes being separated by a distance less than about 0.140 inches;

a power source electrically connected to the electrodes; and,

a water source flowably connected to the inlet.

31. A system according to claim 30 wherein the flow through device is shaped as a conduit or tube and the conduit or tube has inlet and outlet ends, the long axis and contains the electrodes.

32. A system according to claim 30 or 31 wherein the electrodes are composed of metal, a metal oxide or a combination thereof.

33. A system according to claim 30 or 31 wherein the flow through device, conduit or tube has an inner wall, the at least one anode is an anode set, the at least one cathode is a cathode set and the arrangement of the electrodes places one of the anode set and the cathode set next to the inner wall and the other set inside the set next to the inner wall.

34. A system according to claim 33 wherein the anode and cathode sets have a concentric arrangement.

35. A system according to claim 30 or 31 wherein a multiple number of anode and cathode electrodes are present.

36. A system according to claim 35 wherein the flow through device, conduit or tube has an inner wall, the multiple number of anodes is an anode set, the multiple number of cathodes is a cathode set, the arrangement of the sets of electrodes places one set next to the inner wall and the other set inside the set next to the inner wall.

37. A system according to claim 36 wherein each electrode of each set of electrodes has a width such that each set of electrodes approximates a cylinder.

38. A system according to claim 37 wherein the cylinders have a concentric arrangement.

39. A system according to claim 30 wherein the flow through device, power source and water source operate to electrolytically generate microbubbles and nanobubbles of oxygen in the liquid water or aqueous medium and the microbubbles and nanobubbles are substantially incapable of breaking the surface tension of the water.

40. A method for treating organic and/or inorganic pollutants comprising flowing water through the system of claim 30 or 31 while applying a current to the electrodes of the emitter to produce oxygenated water and applying the oxygenated water to the organic pollutants.

41. A method according to claim 40 wherein the oxygenated water comprises microbubbles and nanobubbles of oxygen in the liquid water or aqueous medium, and the microbubbles and nanobubbles are substantially incapable of breaking the surface tension of the water.

42. A method according to claim 40 wherein applying the oxygenated water to the organic and/or inorganic pollutants cleans up the pollutants.

43. A method for cleaning waste and filth at least with oxygenated water, comprising;

flowing liquid water through an emitter comprising

a flow though device which comprises a conduit or tube with an inner wall, an inlet end, an outlet end and a long axis measured from the inlet to outlet ends, the conduit or tube containing at least one anode electrode and at least one cathode electrode, both of a grid design, the electrodes having long axes which are parallel to the long axis of the conduit or tube and a physical arrangement of the electrodes places one of the electrodes next to the inner wall and the other electrode inside the electrode next to the inner wall, the electrodes being separated by a distance less than about 0.140 inches, wherein the liquid water enters the inlet of the conduit or tube and exits the outlet of the conduit or tube,

applying a current to the electrodes through a power source electrically connected to the

electrodes while flowing liquid water through the emitter to produce oxygenated water; and,

contacting the waste and filth at least with the oxygenated water.

44. A method according to claim 43 wherein the electrodes are composed of a metal or metal oxide or a combination thereof.

45. A method according to claim 43 wherein a multiple number of anode and cathode electrodes are present.

46. A method according to claim 45 wherein the multiple number of anodes is an anode set, the multiple number of cathodes is a cathode set, the arrangement of the sets of electrodes places one set next to the inner wall and the other set inside the set next to the inner wall.

47. A method according to claim 46 wherein each electrode of each set of electrodes has a width such that each set of electrodes approximates a cylinder.

48. A method according to claim 47 wherein the cylinders have a concentric arrangement.

49. A method according to claim 43 wherein the oxygenated water contains microbubbles and nanobubbles of oxygen in the water, the microbubbles and nanobubbles being substantially incapable of breaking the surface tension of the water.

REMARKS

Applicant presents this preliminary amendment for his reissue application to correct errors of the claims of original U.S. Patent No. 7,670,495 in that those claims recite subject matter that is less in scope than Applicant was entitled to claim. As indicated in the accompanying Reissue Declaration, all errors that are addressed and corrected by this preliminary amendment arose without any deceptive intention on the part of Applicant.

Claim 2 of the original patent has been amended and pursuant to M.P.E.P 1411.01, the earlier correction of claim 2 provided by the Certificate of Correction has been made in the text of the copy of the printed patent included with this Reissue Filing.

The new claims presented by this preliminary amendment are directed to the same general invention as that disclosed by the original patent as required by 35 U.S.C. §251. Claims 13 – 29 generally are directed to an emitter as is disclosed at col. 2, line 63 – col. 3, line 43 of the original patent. Claims 30-39 are directed to a system incorporating a flow through device, power source and water source as are disclosed at col. 3, lines 23-43 of the original patent. Claims 40 – 49 are directed to methods for treatment of waste and pollution as disclosed at col. 3, lines 36 – 43, Example 7 and claim 9 of the original patent.

Support in the specification for the term recitations of the new claims is provided in the following chart.

CHART SHOWING DISCLOSURE SUPPORT FOR THE NEW CLAIMS

Claim and Term	Location	Phrase
13 – Flow Through Device with inlet and outlet ends and a long axis	Col. 3, lines 23 - 30	A flow-through model is provided which may be connected in-line to a watering hose … The flow-through model can be formed into a tube … Alternatively the anodes and cathodes may be in plates parallel to the long axis of the tube…
At least one anode, at least one cathode	Col. 3, lines 1-14, issued claim 7	The anode and cathode (eg., single electrodes) are separated by a critical distance … a plurality of anodes, a plurality of cathodes (claim 7).
13 - Electrodes having a grid design	Col. 3, line 25	The electrodes may be formed into open grids
13 – Electrode arrangement of long axes parallel to long axis of device	Col. 3, lines 28-30	Anodes and cathodes may be in plates parallel to the long axis of the tube

13 – electrodes being separated by a distance of less than about 0.140 inches	Col. 3, lines 11-13; Col. 4, lines 46-54	In order to form microbubbles and nanobubbles, the anode and cathode are separated by a critical distance. The critical distance ranges from 0.005 inches to 0.140 inches.
14 – flow through device shaped as a conduit	Col. 3, lines 23-26, originally issued claim 1	A flow-through model is provided which may be connected in-line to a watering hose…Placing the emitter within a conduit
15 - flow through device is shaped as a tube	Col. 3, lines 23-26	A flow-through model is provided which may be connected in-line to a watering hose…The flow-through model can be formed into a tube
16 – electrodes separated by a nonconductive spacer	Col. 4, lines 64-65	The anode and cathode are separated by a non-conducting spacer
17 – distance of from about 0.005 inches to about 0.140 inches	Col. 3, lines 11-13; col. 4, lines 52-54	Therefore, the critical distance for microbubble and nanobubble formation was determined to be between 0.005 inches and 0.140 inches
18 – distance of less than about 0.060 inches	Col. 3, lines 13 - 14	The preferred critical distance is from 0.045 to 0.060 inches

19 - tube has inner wall and the arrangement of the set of electrodes places one set next to the inner wall and the other set inside the electrode next to the wall	Col. 3, lines 23-28,	The flow-through model can be formed into a tube… In this model, the anode is placed toward the outside of the tube and the cathode is placed on the inside.
20 – electrodes have a concentric arrangement	Col. 3, lines 11-14 and lines 23-30	Electrodes are inside of a tube, electrodes have a grid design, one electrode is next to the inner wall of the tube and the other is inside the electrode next to the wall. Because the tube is cylinder shaped and one electrode is inside the other, the electrodes have a concentric arrangement.
21 – electrodes composed of metal or metal oxide …	Col. 3, lines 1-2, issued claim 3	The electrodes may be a metal or oxide of at least one metal
22 – multiple number of electrodes	Issued claim 7	Plurality of anodes and cathodes

23 - tube has inner wall and the arrangement of the set of multiple electrodes places one set next to the inner wall and the other set inside the electrode next to the wall	Col. 3, lines 23-28, Issued claim 7	The flow-through model can be formed into a tube… In this model, the anode is placed toward the outside of the tube and the cathode is placed on the inside, plurality of anodes and cathodes
24 – each set of electrodes approximates a cylinder	Col. 3, lines 23-28, issued claim 7	Multiple number of electrodes arranged along the inner wall of the tube yields a set of electrodes arranged as a cylinder, tube is a cylinder.
25 – cylinders have a concentric arrangement	Col. 3, lines 11-14 and lines 23-30	Electrodes are inside of a tube, electrodes have a grid design, one set of multiple electrodes is next to the inner wall of the tube and the other set is inside the set next to the wall. Because the tube is cylinder shaped and one set of electrodes is inside the other, the cylinder shaped sets of electrodes have a concentric arrangement.
26 - power source	Originally Issued claim 2	Power source

27 – liquid water source flowably connected to device, conduit or tube	Col. 3, lines 23-24	A flow-through model is provide which may be connected in-line to a watering hose
28 – control circuit	Col. 5, lines 26-38	It is convenient to attach a control circuit …
29 - microbubbles of oxygen having certain characteristics are formed	Col. 2, line 63 – col. 4, line 67; col. 4, lines 10-15; originally issued claim 2	This invention provides an oxygen emitter which is an electrolytic cell which generates very small microbubbles and nanobubbles of oxygen in an aqueous medium which bubbles are too small to break the surface tension of the medium resulting in a medium supersaturated with oxygen …
30 – system of flow though device, power source and water source	Col. 3, lines 23-28 Col. 5, lines 31-37; Claim 2	A flow-through model is provided which may be connected in –line to a watering hose …a power source all in electrical communication with each other
31 – conduit or tube	See entries for claims 14 and 15	See entries for claims 14 and 15

32 – electrodes of metal …	See entry for claim 21	See entry for claim 21
33 – inner wall, electrode sets and arrangement of electrode sets	See entry for claims 19 and 23	See entry for claim 23
34 – concentric arrangement	See entry for claim 20	See entry for claim 20
35 – multiple number of electrodes	See entry for claim 22	See entry for claim 22
36 – multiple number of electrodes, arrangement of sets of electrodes relative to the inner wall and each other	See entry for claim 23	See entry for claim 23
37 – each set of electrodes approximates a cylinder	See entry for claim 24	See entry for claim 24
38 – concentric arrangement	See entry for claim 25	See entry for claim 25
39 - generation of microbubbles with certain characteristics	See entry for claim 29	See entry for claim 29

40 – method for treating organic pollutants	Col. 1, lines 38-43; col. 3, lines 41-43	Organic pollutants from agricultural, municipal and industrial facilities spread through the ground and surface water and adversely affect life forms. Many pollutants are toxic, carcinogenic or mutagenic. Decomposition of these pollutants is facilitated by oxygen, both by direct chemical detoxifying reactions … Use of the follow-through model for … waste water treatment is disclosed
41 – generation of microbubbles with certain characteristics	See entry for claim 29	See entry for claim 29
42 – cleans up the pollutants	Example 7	Dissolved oxygen increased
43 – method to clean waste and filth	Col. 1, lines 26-48, Example 7	Use of oxygen to clean and detoxify, the waste in waste water is cleaned up through use of the water with microbubbles of oxygen
44 – electrodes are metal and/or metal oxide	See entry for claim 21	See entry for claim 21
45 – multiple number of anodes and cathodes	See entry for claim 22	See entry for claim 22

46 – multiple number of electrodes as a set, arrangement of sets – one next to inner wall, other inside set next to wall	See entry for claim 23	See entry for claim 23
47 – electrode sets approximate cylinders	See entry for claim 24	See entry for claim 24
48 – concentric arrangement	See entry for claim 25	See entry for claim 25
49 – generation of microbubbles with certain characteristics	See entry for claim 29	See entry for claim 29

Applicant submits that the new claims presented by this preliminary amendment are fully supported by the specification and that the new claims do not add new matter to the subject matter disclosed in that specification.

Applicant states that there are no prior or concurrent proceedings in which U.S. Patent No. 7,670,495 is or was involved, including interferences, reissues, reexaminations, or litigations, or is or was the result of such proceedings.

Applicant requests a favorable examination of his application for re-issue of U.S. Patent No. 7,670,495.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's representative at (612) 373-6939 to facilitate prosecution of this application.

If necessary, please charge any additional fees or deficiencies, or credit any overpayments to Deposit Account No. 19-0743.

Respectfully Submitted,

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Date 28 September 2011 By /Albin J. Nelson/

Albin J. Nelson
Reg. No. 28,650

US007670495B2

(12) **United States Patent**
Senkiw

(10) **Patent No.: US 7,670,495 B2**
(45) **Date of Patent: *Mar. 2, 2010**

(54) **FLOW-THROUGH OXYGENATOR**

(75) Inventor: **James Andrew Senkiw**, Minneapolis, MN (US)

(73) Assignee: **Oxygenator Water Technologies, Inc.**, Minnetonka, MN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **12/023,431**

(22) Filed: **Jan. 31, 2008**

(65) **Prior Publication Data**

US 2008/0179259 A1 Jul. 31, 2008

Related U.S. Application Data

(60) Division of application No. 10/732,326, filed on Dec. 10, 2003, now Pat. No. 7,396,441, which is a continuation-in-part of application No. 10/372,017, filed on Feb. 21, 2003, now Pat. No. 6,689,262.

(60) Provisional application No. 60/358,534, filed on Feb. 22, 2002.

(51) **Int. Cl.**

C02F 1/48	(2006.01)
C02F 1/00	(2006.01)
C25B 1/02	(2006.01)
C25B 1/04	(2006.01)

(52) **U.S. Cl.** **210/748**; 210/600; 210/243; 204/245; 204/232; 205/628

(58) **Field of Classification Search** 210/748, 210/600, 243; 204/278, 242, 243, 275.1, 204/232, 286.1, 554, 660; 205/633–638

See application file for complete search history.

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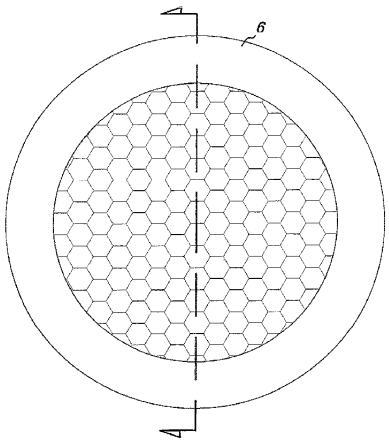
Primary Examiner—Walter D Griffin
Assistant Examiner—Cameron J Allen
(74) *Attorney, Agent, or Firm*—Patterson, Thuente, Skaar & Christensen, P.A.

(57) **ABSTRACT**

An oxygen emitter which is an electrolytic cell is disclosed. When the anode and cathode are separated by a critical distance, very small microbubbles and nanobubbles of oxygen are generated. The very small oxygen bubbles remain in suspension, forming a solution supersaturated in oxygen. A flow-through model for oxygenating flowing water is disclosed. The use of supersaturated water for enhancing the growth of plants is disclosed. Methods for applying supersaturated water to plants manually, by drip irrigation or in hydroponic culture are described. The treatment of waste water by raising the dissolved oxygen with the use of an oxygen emitter is disclosed.

12 Claims, 8 Drawing Sheets



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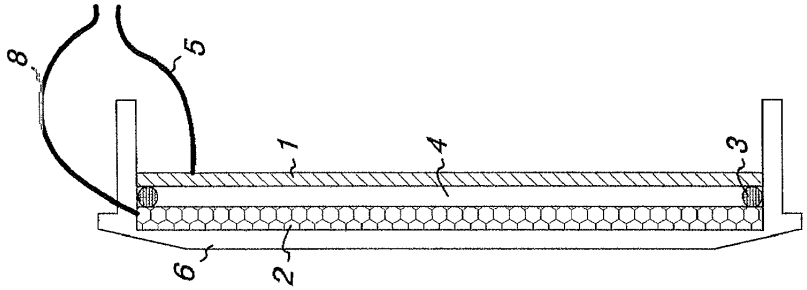


Fig. 1B

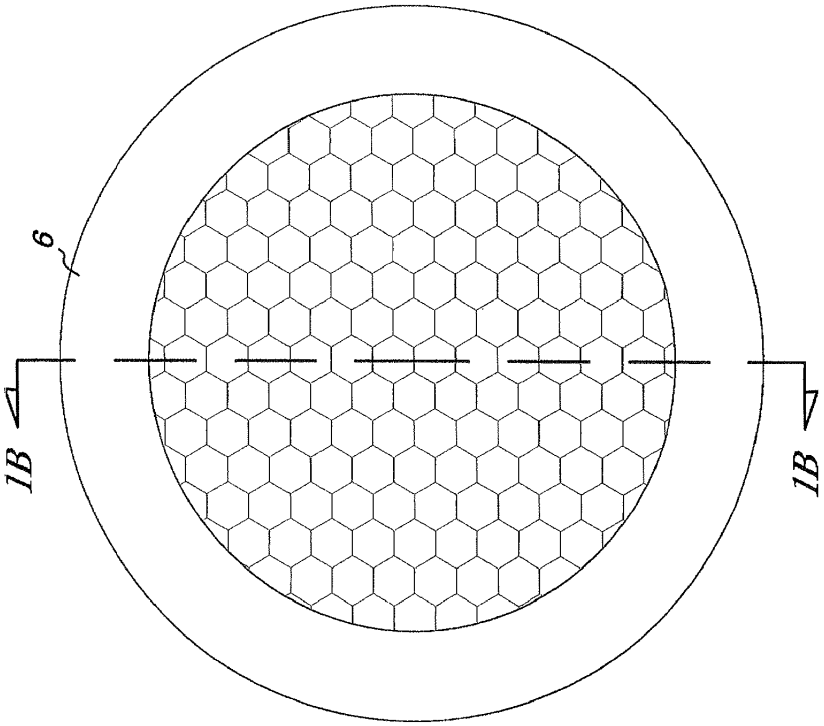


Fig. 1A

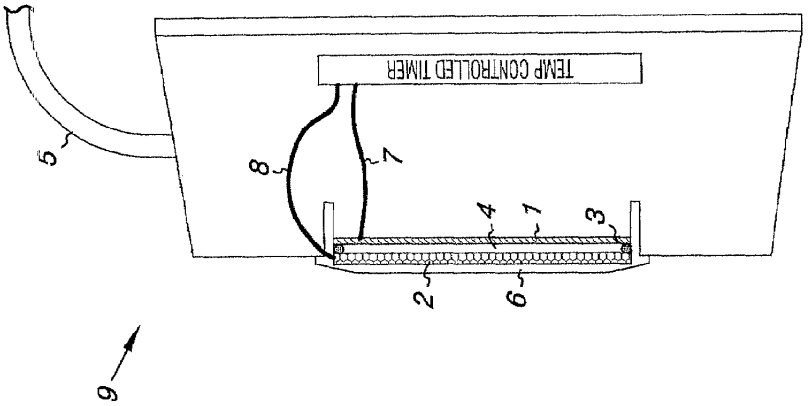


Fig. 2B

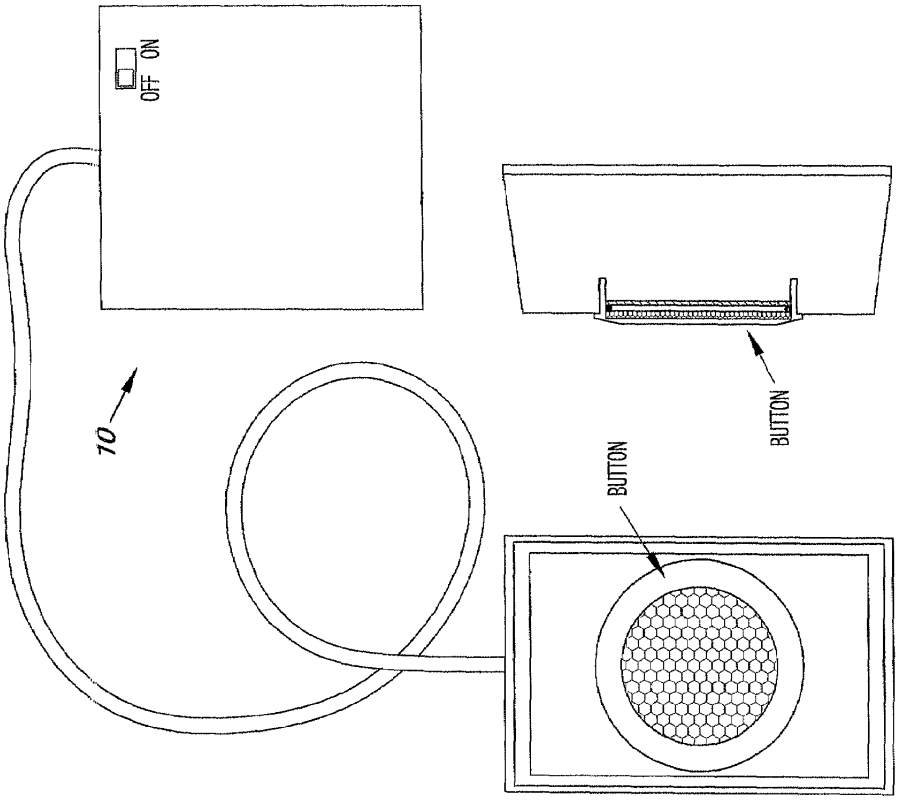


Fig. 2A

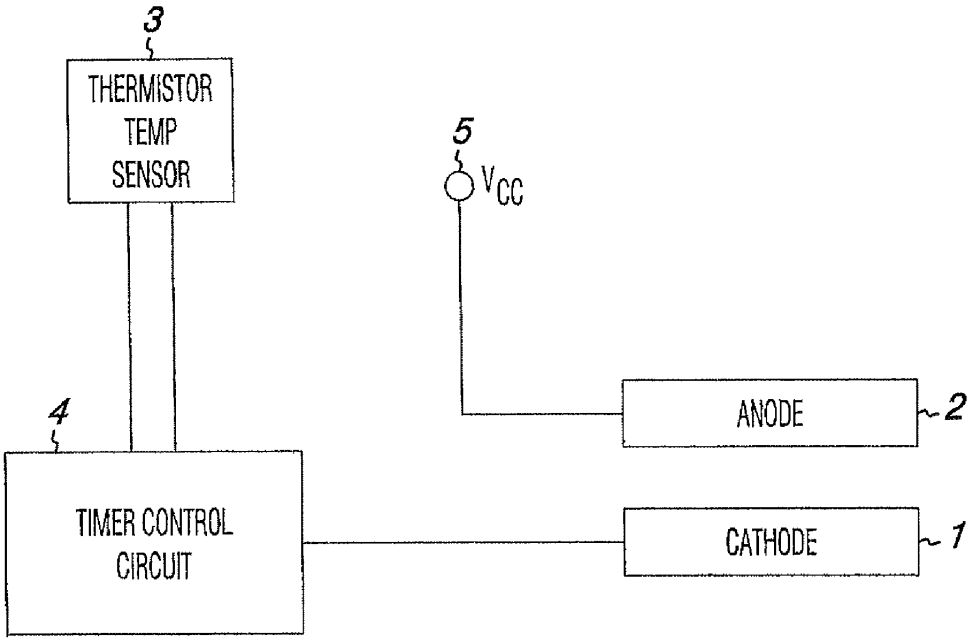

3
THERMISTOR TEMP SENSOR
5
V_{CC}
4
TIMER CONTROL CIRCUIT
ANODE
2
CATHODE
1

Fig. 3

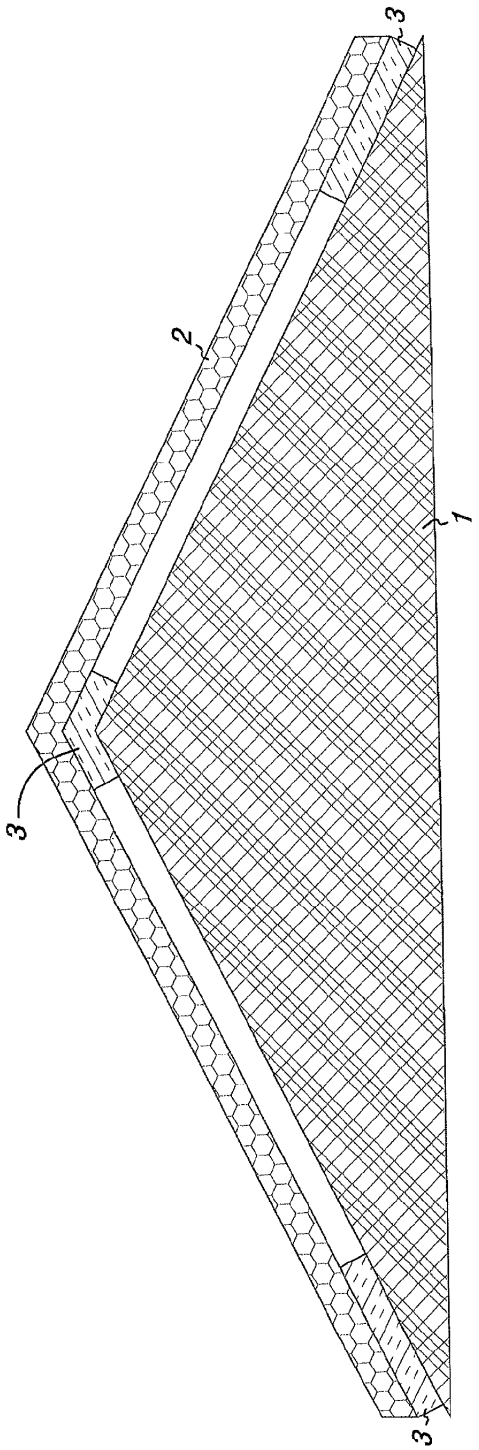


Fig. 4

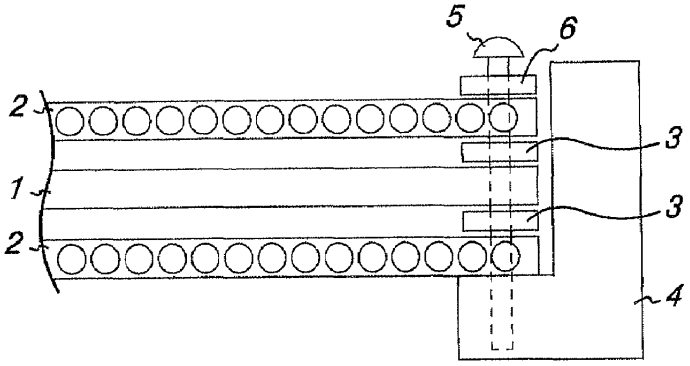


Fig. 5A

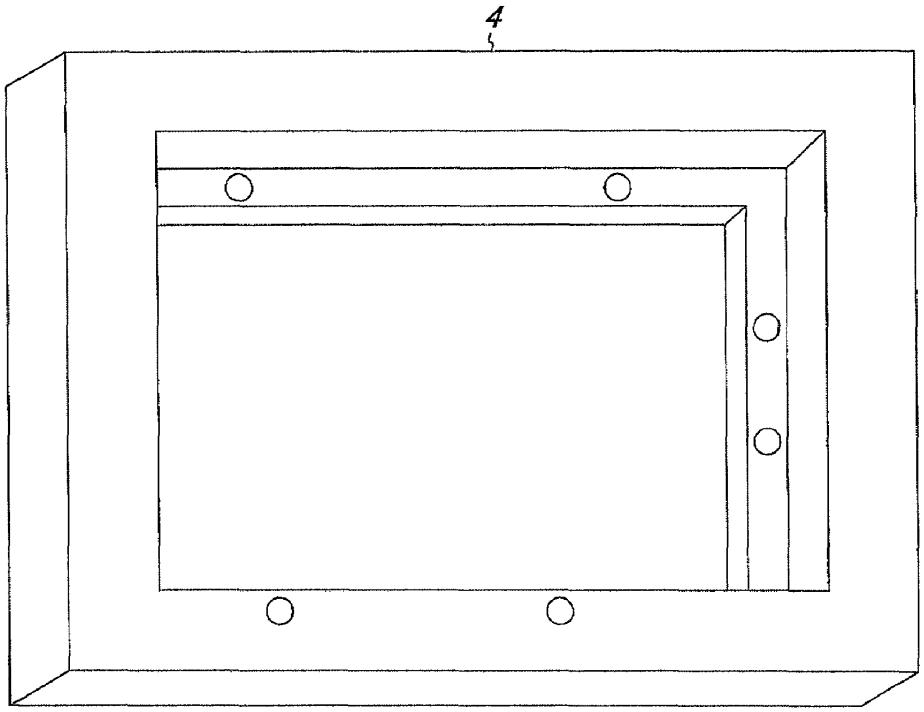


Fig. 5B

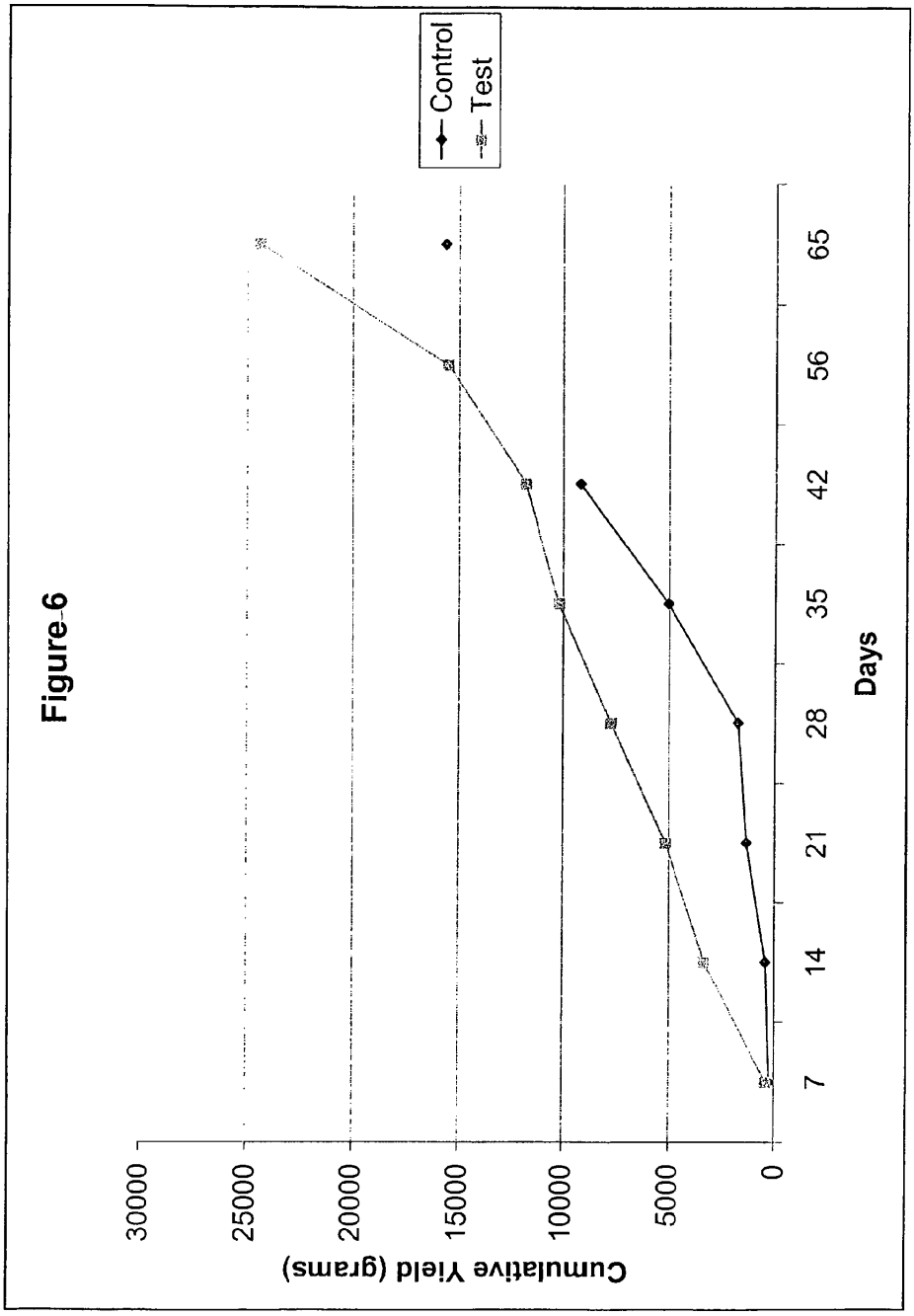

Control
Test
Cumulative Yield (grams)
30000
25000
20000
15000
10000
5000
0
Days
7
14
21
28
35
42
56
65

Figure 6

Fig. 7A

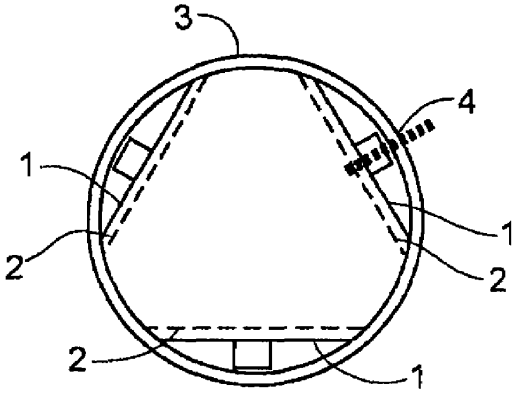
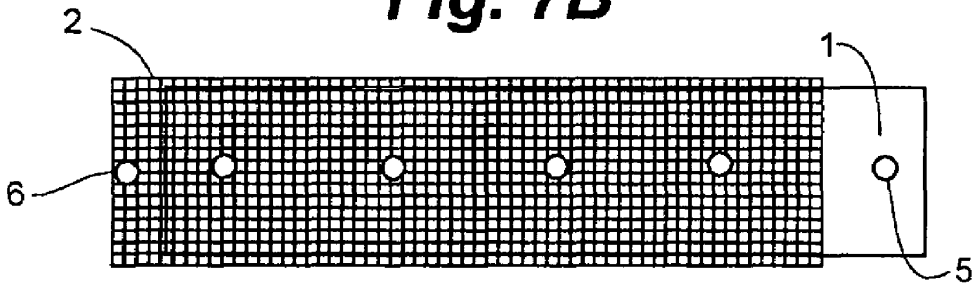


Fig. 7B



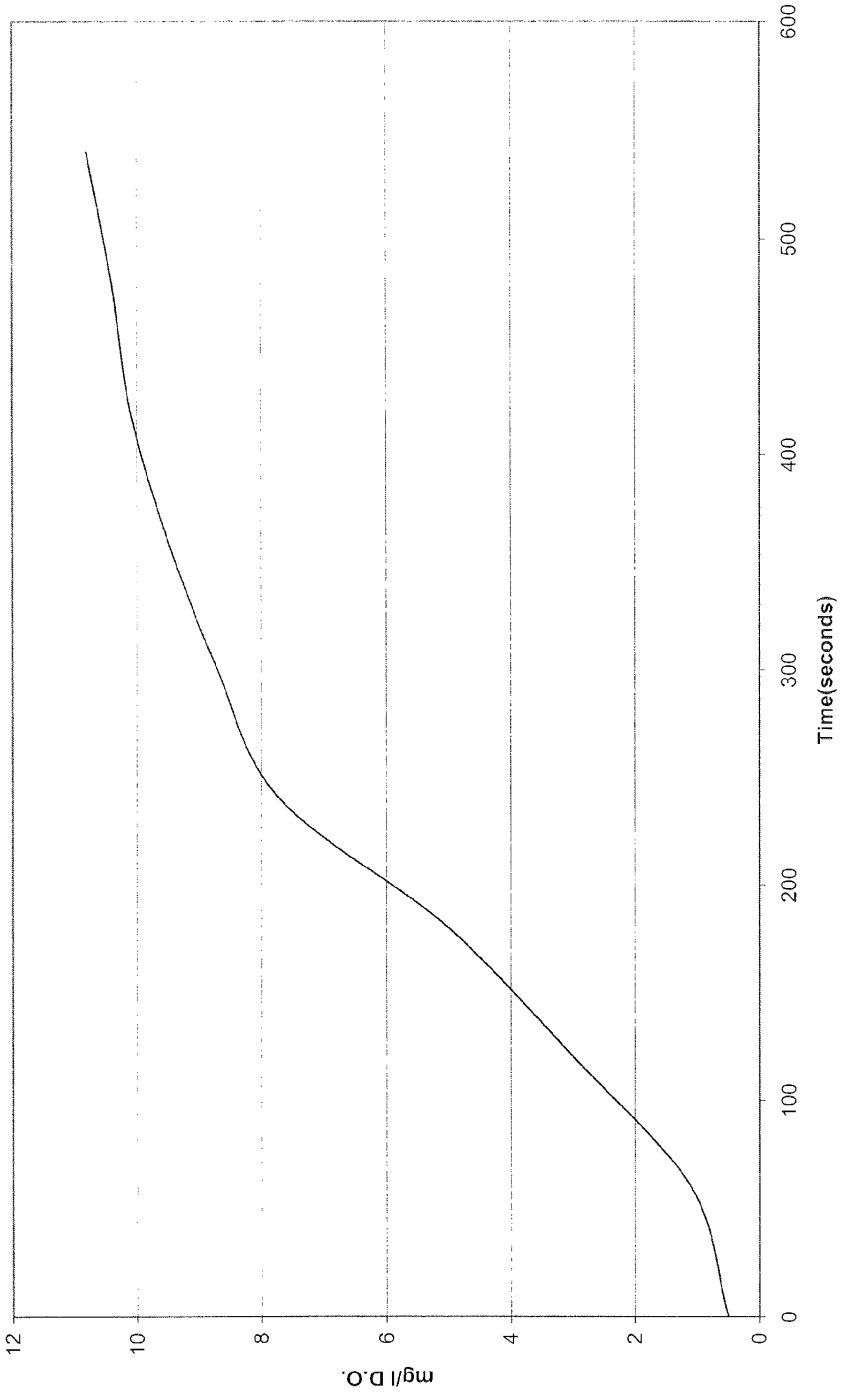


Fig. 8 Time vs D.O.

FLOW-THROUGH OXYGENATOR

RELATED APPLICATIONS

This application is a division of application Ser. No. 10/732,326 filed Dec. 10, 2003, which in turn is a continuation-in-part of application Ser. No. 10/372,017, filed Feb. 21, 2003, now U.S. Pat. No. 6,689,262, which claims the benefit of U.S. Provisional Application No. 60/358,534, filed Feb. 22, 2002, each of which is hereby fully incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates to the electrolytic generation of microbubbles of oxygen for increasing the oxygen content of flowing water. This invention also relates to the use of super-oxygenated water to enhance the growth and yield of plants. The flow-through model is useful for oxygenating water for hydroponic plant culture, drip irrigation and waste water treatment.

BACKGROUND OF THE INVENTION

Many benefits may be obtained through raising the oxygen content of aqueous media. Efforts have been made to achieve higher saturated or supersaturated oxygen levels for applications such as the improvement of water quality in ponds, lakes, marshes and reservoirs, the detoxification of contaminated water, culture of fish, shrimp and other aquatic animals, biological culture and hydroponic culture. For example, fish held in a limited environment such as an aquarium, a bait bucket or a live hold tank may quickly use up the dissolved oxygen in the course of normal respiration and are then subject to hypoxic stress, which can lead to death. A similar effect is seen in cell cultures, where the respiring cells would benefit from higher oxygen content of the medium. Organic pollutants from agricultural, municipal and industrial facilities spread through the ground and surface water and adversely affect life forms. Many pollutants are toxic, carcinogenic or mutagenic. Decomposition of these pollutants is facilitated by oxygen, both by direct chemical detoxifying reactions or by stimulating the growth of detoxifying microflora. Contaminated water is described as having an increased biological oxygen demand (BOD) and water treatment is aimed at decreasing the BOD so as to make more oxygen available for fish and other life forms.

The most common method of increasing the oxygen content of a medium is by sparging with air or oxygen. While this is a simple method, the resulting large bubbles produced simply break the surface and are discharged into the atmosphere. Attempts have been made to reduce the size of the bubbles in order to facilitate oxygen transfer by increasing the total surface area of the oxygen bubbles. U.S. Pat. No. 5,534,143 discloses a microbubble generator that achieves a bubble size of about 0.10 millimeters to about 3 millimeters in diameter. U.S. Pat. No. 6,394,429 ("the '429 patent") discloses a device for producing microbubbles, ranging in size from 0.1 to 100 microns in diameter, by forcing air into the fluid at high pressure through a small orifice.

When the object of generating bubbles is to oxygenate the water, either air, with an oxygen content of about 21%, or pure oxygen may be used. The production of oxygen and hydrogen by the electrolysis of water is well known. A current is applied across an anode and a cathode which are immersed in an aqueous medium. The current may be a direct current from a battery or an AC/DC converter from a line. Hydrogen gas is produced at the cathode and oxygen gas is produced at the anode. The reactions are:

AT THE CATHODE:	$4H_2O + 4e^- \rightarrow 4OH^- + 2H_2$
AT THE ANODE:	$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$
NET REACTION:	$6H_2O \rightarrow 4OH^- + 4H^+ + 2H_2 + O_2$

286 kilojoules of energy is required to generate one mole of oxygen.

The gasses form bubbles which rise to the surface of the fluid and may be collected. Either the oxygen or the hydrogen may be collected for various uses. The "electrolytic water" surrounding the anode becomes acidic while the electrolytic water surrounding the cathode becomes basic. Therefore, the electrodes tend to foul or pit and have a limited life in these corrosive environments.

Many cathodes and anodes are commercially available. U.S. Pat. No. 5,982,609 discloses cathodes comprising a metal or metallic oxide of at least one metal selected from the group consisting of ruthenium, iridium, nickel, iron, rhodium, rhenium, cobalt, tungsten, manganese, tantalum, molybdenum, lead, titanium, platinum, palladium and osmium. Anodes are formed from the same metallic oxides or metals as cathodes. Electrodes may also be formed from alloys of the above metals or metals and oxides co-deposited on a substrate. The cathode and anodes may be formed on any convenient support in any desired shape or size. It is possible to use the same materials or different materials for both electrodes. The choice is determined according to the uses. Platinum and iron alloys ("stainless steel") are often preferred materials due to their inherent resistance to the corrosive electrolytic water. An especially preferred anode disclosed in U.S. Pat. No. 4,252,856 comprises vacuum deposited iridium oxide.

Holding vessels for live animals generally have a high population of animals which use up the available oxygen rapidly. Pumps to supply oxygen have high power requirements and the noise and bubbling may further stress the animals. The available electrolytic generators likewise have high power requirements and additionally run at high voltages and produce acidic and basic water which are detrimental to live animals. Many of the uses of oxygenators, such as keeping bait or caught fish alive, would benefit from portable devices that did not require a source of high power. The need remains for quiet, portable, low voltage means to oxygenate water.

It has also been known that plant roots are healthier when oxygenated water is applied. It is thought that oxygen inhibits the growth of deleterious fungi. The water sparged with air as in the '429 patent was shown to increase the biomass of hydroponically grown cucumbers and tomatoes by about 15%.

The need remains for oxygenator models suitable to be placed in-line in water distribution devices so as to be applied to field as well as hydroponic culture.

SUMMARY OF THE INVENTION

This invention provides an oxygen emitter which is an electrolytic cell which generates very small microbubbles and nanobubbles of oxygen in an aqueous medium, which bubbles are too small to break the surface tension of the medium, resulting in a medium supersaturated with oxygen.

The electrodes may be a metal or oxide of at least one metal selected from the group consisting of ruthenium, iridium, nickel, iron, rhodium, rhenium, cobalt, tungsten, manganese, tantalum, molybdenum, lead, titanium, platinum, palladium and osmium or oxides thereof. The electrodes may be formed into open grids or may be closed surfaces. The most preferred cathode is a stainless steel mesh. The most preferred mesh is a {fraction (1/16)} inch grid. The most preferred anode is platinum and iridium oxide on a support. A preferred support is titanium.

In order to form microbubbles and nanobubbles, the anode and cathode are separated by a critical distance. The critical distance ranges from 0.005 inches to 0.140 inches. The preferred critical distance is from 0.045 to 0.060 inches.

Models of different size are provided to be applicable to various volumes of aqueous medium to be oxygenated. The public is directed to choose the applicable model based on volume and power requirements of projected use. Those models with low voltage requirements are especially suited to oxygenating water in which animals are to be held.

Controls are provided to regulate the current and timing of electrolysis.

A flow-through model is provided which may be connected in-line to a watering hose or to a hydroponic circulating system. The flow-through model can be formed into a tube with triangular cross-section. In this model, the anode is placed toward the outside of the tube and the cathode is placed on the inside, contacting the water flow. Alternatively, the anodes and cathodes may be in plates parallel to the long axis of the tube, or may be plates in a wafer stack. Alternately, the electrodes may be placed in a side tube ("T" model) out of the direct flow of water. Protocols are provided to produce superoxygenated water at the desired flow rate and at the desired power usage. Controls are inserted to activate electrolysis when water is flowing and deactivate electrolysis at rest.

This invention includes a method to promote growth and increase yield of plants by application of superoxygenated water. The water treated with the emitter of this invention is one example of superoxygenated water. Plants may be grown in hydroponic culture or in soil. The use of the flow-through model for drip irrigation of crops and waste water treatment is disclosed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is the O_2 emitter of the invention.

FIG. **2** is an assembled device.

FIG. **3** is a diagram of the electronic controls of the O_2 emitter.

FIG. **4** shows a funnel or pyramid variation of the O_2 emitter.

FIG. **5** shows a multilayer sandwich O_2 emitter.

FIG. **6** shows the yield of tomato plants watered with superoxygenated water.

FIG. **7** shows an oxygenation chamber suitable for flow-through applications. FIG. **7**A is a cross section showing arrangement of three plate electrodes. FIG. **7**B is a longitudinal section showing the points of connection to the power source.

FIG. **8** is a graph showing the oxygenation of waste water.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

For the purpose of describing the present invention, the following terms have these meanings:

"Critical distance" means the distance separating the anode and cathode at which evolved oxygen forms microbubbles and nanobubbles.

"Critical distance" means the distance separating the anode and cathode at which evolved oxygen forms microbubbles and nanobubbles.

"O_2 emitter" means a cell comprised of at least one anode and at least one cathode separated by the critical distance.

"Metal" means a metal or an alloy of one or more metals.

"Microbubble" means a bubble with a diameter less than 50 microns.

"Nanobubble" means a bubble with a diameter less than that necessary to break the surface tension of water. Nanobubbles remain suspended in the water, giving the water an opalescent or milky appearance.

"Supersaturated" means oxygen at a higher concentration than normal calculated oxygen solubility at a particular temperature and pressure.

"Superoxygenated water" means water with an oxygen content at least 120% of that calculated to be saturated at a temperature.

"Water" means any aqueous medium with resistance less than one ohm per square centimeter; that is, a medium that can support the electrolysis of water. In general, the lower limit of resistance for a medium that can support electrolysis is water containing more than 2000 ppm total dissolved solids.

The present invention produces microbubbles and nanobubbles of oxygen via the electrolysis of water. As molecular oxygen radical (atomic weight 8) is produced, it reacts to form molecular oxygen, O_2. In the special dimensions of the invention, as explained in more detail in the following examples, O_2 forms bubbles which are too small to break the surface tension of the fluid. These bubbles remain suspended indefinitely in the fluid and, when allowed to build up, make the fluid opalescent or milky. Only after several hours do the bubbles begin to coalesce on the sides of the container and the water clears. During that time, the water is supersaturated with oxygen. In contrast, the H_2 formed readily coalesces into larger bubbles which are discharged into the atmosphere, as can be seen by bubble formation at the cathode.

The first objective of this invention was to make an oxygen emitter with low power demands, low voltage and low current for use with live animals. For that reason, a small button emitter was devised. The anode and cathode were set at varying distances. It was found that electrolysis took place at very short distances before arcing of the current occurred. Surprisingly, at slightly larger distances, the water became milky and no bubbles formed at the anode, while hydrogen continued to be bubbled off the cathode. At distance of 0.140 inches between the anode and cathode, it was observed that the oxygen formed bubbles at the anode. Therefore, the critical distance for microbubble and nanobubble formation was determined to be between 0.005 inches and 0.140 inches.

EXAMPLE 1

Oxygen Emitter

As shown in FIG. **1**, the oxygen evolving anode **1** selected as the most efficient is an iridium oxide coated single sided sheet of platinum on a support of titanium (Eltech, Fairport Harbor, Ohio). The cathode **2** is a (fraction (1/16)} inch mesh (size 8 mesh) marine stainless steel screen. The anode and cathode are separated by a non-conducting spacer **3** containing a gap **4** for the passage of gas and mixing of anodic and cathodic water and connected to a power source through a

connection point **5**. FIG. **2** shows a plan view of the assembled device. The O_2 emitter **6** with the anode connecting wire **7** and the cathode connecting wire **8** is contained in an enclosure **9**, connected to the battery compartment **10**. The spacer thickness is critical as it sets the critical distance. It must be of sufficient thickness to prevent arcing of the current, but thin enough to separate the electrodes by no more than 0.140 inches. Above that thickness, the power needs are higher and the oxygen bubbles formed at higher voltage will coalesce and escape the fluid. Preferably, the spacer is from 0.005 to 0.075 inches thick. At the lower limits, the emitter tends to foul more quickly. Most preferably, the spacer is about 0.050 inches thick. The spacer may be any nonconductive material such as nylon, fiberglass, Teflon®, polymer or other plastic. Because of the criticality of the space distance, it is preferable to have a non-compressible spacer. It was found that Buna, with a durometer measure of 60 was not acceptable due to decomposition. Viton, a common fluoroelastomer, has a durometer measure of 90 and was found to hold its shape well.

In operation, a small device with an O_2 emitter 1.485 inches in diameter was driven by 4AA batteries. The critical distance was held at 0.050 inches with a Viton spacer. Five gallons of water became saturated in seven minutes. This size is suitable for raising oxygen levels in an aquarium or bait bucket.

It is convenient to attach a control circuit which comprises a timer that is thermostatically controlled by a temperature sensor which determines the off time for the cathode. When the temperature of the solution changes, the resistance of the thermistor changes, which causes an off time of a certain duration. In cool water, the duration is longer so in a given volume, the emitter generates less oxygen. When the water is warmer and therefore hold less oxygen, the duration of off time is shorter. Thus the device is self-controlled to use power most economically. FIG. **3** shows a block diagram of a timer control with anode **1**, cathode **2**, thermistor temperature sensor **3**, timer control circuit **4** and wire from a direct current power source **5**.

EXAMPLE 2

Measurement of O_2 Bubbles

Attempts were made to measure the diameter of the O_2 bubbles emitted by the device of Example 1. In the case of particles other than gasses, measurements can easily be made by scanning electron microscopy, but gasses do not survive electron microscopy. Large bubble may be measured by pore exclusion, for example, which is also not feasible when measuring a gas bubble. A black and white digital, high contrast, backlit photograph of treated water with a millimeter scale reference was shot of water produced by the emitter of Example 1. About 125 bubbles were seen in the area selected for measurement. Seven bubbles ranging from the smallest clearly seen to the largest were measured. The area was enlarged, giving a scale multiplier of 0.029412.

Recorded bubble diameters at scale were 0.16, 0.22, 0.35, 0.51, 0.76, 0.88 and 1.09 millimeters. The last three were considered outliers by reverse analysis of variance and were assumed to be hydrogen bubbles. When multiplied by the scale multiplier, the assumed O_2 bubbles were found to range from 4.7 to 15 microns in diameter. This test was limited by the resolution of the camera and smaller bubbles in the nanometer range could not be resolved. It is known that white light cannot resolve features in the nanometer size range, so monochromatic laser light may give resolution sensitive enough to measure smaller bubbles. Efforts continue to increase the sensitivity of measurement so that sub-micron diameter bubbles can be measured.

EXAMPLE 3

Other Models of Oxygen Emitter

Depending on the volume of fluid to be oxygenated, the oxygen emitter of this invention may be shaped as a circle, rectangle, cone or other model. One or more may be set in a substrate that may be metal, glass, plastic or other material. The substrate is not critical as long as the current is isolated to the electrodes by the nonconductor spacer material of a thickness from 0.005 to 0.075 inches, preferably 0.050 inches. It has been noticed that the flow of water seems to be at the periphery of the emitter, while the evolved visible bubbles (H_2) arise at the center of the emitter. Therefore, a funnel or pyramidal shaped emitter was constructed to treat larger volumes of fluid. FIG. **4** is a cross sectional diagram of such an emitter. The anode **1** is formed as an open grid separated from a marine grade stainless steel screen cathode **2** by the critical distance by spacer **3** around the periphery of the emitter and at the apex. This flow-through embodiment is suitable for treating large volumes of water rapidly.

The size may be varied as required. A round emitter for oxygenating a bait bucket may be about 2 inches in diameter, while a 3-inch diameter emitter is adequate for oxygenating a 10 to 40 gallon tank. The live well of a fishing boat will generally hold 40 to 80 gallons of water and require a 4-inch diameter emitter. It is within the scope of this invention to construct larger emitters or to use several in a series to oxygenate larger volumes. It is also within the scope of this invention to vary the model to provide for low voltage and amperage in cases where the need for oxygen is moderate and long lasting or conversely, to supersaturate water very quickly at higher voltage and amperage. In the special dimensions of the present invention, it has been found that a 6 volt battery supplying a current as low as 40 milliamperes is sufficient to generate oxygen. Such a model is especially useful with live plants or animals, while it is more convenient for industrial use to use a higher voltage and current. Table I shows a number of models suitable to various uses.

TABLE I

Emitter Model	Gallons	Volts	Amps Max.	Ave	Watts
Bait keeper	5	6	0.090	0.060	0.36
Livewell	32	12	0.180	0.120	1.44
OEM 2 inch	10	12	0.210	0.120	1.44
Bait store	70	12	0.180	0.180	2.16
Double cycle	2	12	0.180	0.180	2.16
OEM 3 inch	50	12	0.500	0.265	3.48
OEM 4 inch	80	12	0.980	0.410	4.92
Water pail	2	24	1.200	1.200	28.80
Plate	250	12	5.000	2.500	30.00

EXAMPLE 4

Multilayer Sandwich O_2 Emitter

An O_2 emitter was made in a multilayer sandwich embodiment. (FIG. **5**) An iridium oxide coated platinum anode **1** was formed into a grid to allow good water flow and sandwiched between two stainless steel screen cathodes **2**. Spacing was held at the critical distance by nylon spacers **3**. The embodiment illustrated is held in a cassette **4** which is secured by nylon bolt **5** with a nylon washer **6**. The dimensions selected were:

cathode screen	0.045 inches thick
nylon spacer	0.053 inches thick
anode grid	0.035 inches thick
nylon spacer	0.053 inches thick
cathode screen	0.045 inches thick,

for an overall emitter thickness of 0.231 inches thick inches.

If a more powerful emitter is desired, it is within the scope of this invention to repeat the sequence of stacking. For example, an embodiment may easily be constructed with this sequence: cathode, spacer, anode, spacer, cathode, spacer, anode, spacer, cathode, spacer, anode, spacer, cathode. The number of layers in the sandwich is limited only by the power requirements acceptable for an application.

EXAMPLE 5

Effect of Superoxygenated Water on the Growth of Plants

It is known that oxygen is important for the growth of plants. Although plants evolve oxygen during photosynthesis, they also have a requirement for oxygen for respiration. Oxygen is evolved in the leaves of the plants, while often the roots are in a hypoxic environment without enough oxygen to support optimum respiration, which can be reflected in less than optimum growth and nutrient utilization. Hydroponically grown plants are particularly susceptible to oxygen deficit in the root system. U.S. Pat. No. 5,887,383 describes a liquid supply pump unit for hydroponic cultures which attain oxygen enrichment by sparging with air. Such a method has high energy requirements and is noisy. Furthermore, while suitable for self-contained hydroponic culture, the apparatus is not usable for field irrigation. In a report available on the web, it was shown that hydroponically grown cucumbers and tomatoes supplied with water oxygenated with a device similar to that described in the '429 patent had increased biomass of about 12% and 17% respectively. It should be noted that when sparged with air, the water may become saturated with oxygen, but it is unlikely that the water is superoxygenated.

A. Superoxygenated Water in Hydroponic Culture.

Two small hydroponic systems were set up to grow two tomato plants. Circulation protocols were identical except that the 2 ½ gallon water reservoir for the Control plant was eroated with and aquarium bubbler and that for the Test plant was oxygenated with a five-inch strip emitter for two minutes prior to pumping. The cycle was set at four minutes of pumping, followed by four minutes of rest. The control water had an oxygen content of about 97% to 103% saturation, that is, it was saturated with oxygen. The test water had an oxygen content of about 153% to 165% saturation, that is, it was supersaturated. The test plant was at least four times the volume of the control plant and began to show what looked like fertilizer burn. At that point the fertilizer for the Test plant was reduced by half. Since the plants were not exposed to natural light but to continuous artificial light in an indoor environment without the natural means of fertilization (wind and/or insects), the experiment was discontinued after three months. At that time, the Test plant but not the Control plant had blossomed.

B. Superoxygenated Water in Field Culture.

A pilot study was designed to ascertain that plants outside the hydroponic culture facility would benefit from the application of oxygen. It was decided to use water treated with the emitter of Example 1 as the oxygen carrier. Since water so treated is supersaturated, it is an excellent carrier of oxygen.

Tomato seeds (Burpee "Big Boy") were planted in one-inch diameter peat and dirt plugs encased in cheese cloth and placed in a tray in a southwest window. Controls were watered once a day with tap water ("Control") or oxygenated water ("Test"). Both Controls and Test sprouted at one week. After five weeks, the Test plants were an average of 11 inches tall while the Controls were an average of nine inches tall. At this time, May 10, when the threat of frost in Minnesota was minimal, the plants were transplanted to 13 inch diameter pots with drainage holes. Four inches of top soil was added to each pot, topped off with four inches of Scott's Potting Soil. The pots were placed outside in a sunny area with at least eight hours a day of full sun. The plants were watered as needed with either plain tap water (Control) or oxygenated water (Test). The oxygenated water was produced by use of the emitter of Example 1 run for one-half hour in a five-gallon container of water. Previous experiments showed that water thus treated had an oxygen content from 160% to 260% saturation. The Test plants flowered on June 4, while the Controls did not flower until June 18. For both groups, every plant in the group first had flowers on the same day. All plants were fertilized on July 2 and a soaker hose provided because the plants were now so big that watering by hand was difficult. The soaker hose was run for one half to one hour each morning, depending on the weather, to a point at which the soil was saturated with water. One half hour after the soaker hose was turned off, about 750 ml of superoxygenated water was applied to each of the Test plants.

The Test plants were bushier than the Controls although the heights were similar. At this time, there were eight Control plants and seven Test plants because one of the Test plants broke in a storm. On July 2, the control plants averaged about 17 primary branches from the vine stem, while the control plants averaged about 13 primary branches from the vine stem. As the tomatoes matured, each was weighed on a kitchen scale at harvest. The yield history is shown in Table II.

TABLE II

Week of:	Control, grams tomatoes from eight plants/ cumulative total		Test, grams tomatoes from seven plants/ cumulative total	
July 27	240		400	
August 3	180	420	2910	3310
August 10	905	1325	1830	5140
August 17	410	1735	2590	7730
August 24	3300	5035	2470	10200
August 31	4150	9175	1580	11780
September 15	not weighed		3710	15490
Final Harvest September 24	6435	15620	8895	24385

The total yield for the eight Control plants was 15620 grams or 1952 grams of tomatoes per plant.

The total yield for the seven Test plants was 24385 grams or 3484 grams of tomatoes per plant, an increase in yield of about 79% over the Control plants.

FIG. **6** shows the cumulative total as plotted against time. Not only did the Test plants blossom and bear fruit earlier, but that the Control plants never caught up to the test plants in the short Minnesota growing season. It should be noted that the experiment was terminated because of predicted frost. All fruits, both green and red, were harvested and weighed at that point.

EXAMPLE 6

Flow-Through Emitter for Agricultural Use

In order to apply the findings of example 5 to agricultural uses, an emitter than can oxygenate running water efficiently was developed. In FIG. **7**(A), the oxygenation chamber is comprised of three anodes **1** and cathodes **2**, of appropriate size to fit inside a tube or hose and separated by the critical distance are placed within a tube or hose **3** at 120° angles to each other. The anodes and cathodes are positioned with stabilizing hardware **4**. The stabilizing hardware, which can be any configuration such as a screw, rod or washer, is preferably formed from stainless steel. FIG. **7**(B) shows a plan view of the oxygenation chamber with stabilizing hardware **4** serving as a connector to the power source and stabilizing hardware **5** serving as a connector to the power source. The active area is shown at **6**.

This invention is not limited to the design selected for this embodiment. Those skilled in the art can readily fabricate any of the emitters shown in FIG. **4** or **5**, or can design other embodiments that will oxygenate flowing water. One useful embodiment is the "T" model, wherein the emitter unit is set in a side arm. The emitted bubbles are swept into the water flow. The unit is detachable for easy servicing. Table III shows several models of flow through emitters. The voltage and flowrates were held constant and the current varied. The Dissolved oxygen (DO) from the source was 7.1 mg/liter. The starting temperature was 12.2° C. but the flowing water cooled slightly to 11 or 11.5° C. Without undue experimentation, anyone may easily select the embodiment that best suits desired characteristics from Table III or designed with the teachings of Table III.

TABLE III

MODEL	ACTIVE ELECTRODE AREA, SQ.IN.	VOLTAGE	CURRENT, AMPS.	FLOW RATE GAL/MINUTE	DO OF* SAMPLE AT ONE MINUTE
2-Inch "T"	2	28.3	0.72	12	N/A
3-inch "T"	3	28.3	1.75	12	N/A
2-plate Tube	20	28.3	9.1	12	8.4
3-Plate tube	30	28.3	12.8	12	9.6

*As the apparatus runs longer, the flowing water becomes milky, indicating supersaturation. The one-minute time point shows the rapid increase in oxygenation.

The following plants will be tested for response to superoxygenated water: grape vines, lettuce, and radishes in three different climate zones. The operators for these facilities will be supplied with units for drip irrigation. Drip irrigation is a technique wherein water is pumped through a pipe or hose with perforations at the site of each plant to be irrigated. The conduit may be underground or above ground. Since the water is applied directly to the plant rather than wetting the entire field, this technique is especially useful in arid climates or for plants requiring high fertilizer applications.

The superoxygenated water will be applied by drip irrigation per the usual protocol for the respective plants. Growth and yield will be compared to the same plants given only the usual irrigation water. Pest control and fertilization will be the same between test and control plants, except that the operators of the experiments will be cautioned to be aware of the possibility of fertilizer burn in the test plants and to adjust their protocols accordingly.

It is expected that the superoxygenated plants with drip irrigation will show more improved performance with more continuous application of oxygen than did the tomato plants of Example 5, which were given superoxygenated water only once a day.

EXAMPLE 7

Treatment of Waste Water

Waste water, with a high organic content, has a high BOD, due to the bacterial flora. It is desirable to raise the oxygen content of the waste water in order to cause the flora to flocculate. However, it is very difficult to effectively oxygenate such water. Using a 4 inch OEM (see Table I) with a 12 volt battery, four liters of waste water in a five gallon pail were oxygenated. As shown in FIG. **8**, the dissolved oxygen went from 0.5 mg/l to 10.8 mg/l in nine minutes.

Those skilled in the art will readily comprehend that variations, modifications and additions may in the embodiments described herein may be made. Therefore, such variations, modifications and additions are within the scope of the appended claims.

The invention claimed is:

1. A method for treating waste water comprising;

providing a flow-through oxygenator comprising an emitter for electrolytic generation of microbubbles of oxygen comprising an anode separated at a critical distance from a cathode and a power source all in electrical communication with each other,

placing the emitter within a conduit; and

passing waste water through the conduit.

2. An emitter for electrolytic generation of microbubbles of oxygen in an aqueous medium comprising: an anode separated at a critical distance from a cathode, a nonconductive spacer maintaining the separation of the anode and cathode, the nonconductive spacer having a spacer thickness between 0.005 to 0.050 inches such that the critical distance is less than 0.060 inches and a power source all in electrical communication with each other, wherein the critical distance results in the formation of oxygen bubbles having a bubble diameter less than 0.0006 inches, said oxygen bubbles being incapable of breaking the surface tension of the aqueous medium such that said aqueous medium is supersaturated with oxygen.

3. The emitter of claim **2**, wherein the anode is a metal or a metallic oxide or a combination of a metal and a metallic oxide.

4. The emitter of claim **2**, wherein the anode is platinum and iridium oxide on a support.

5. The emitter of claim **2**, wherein the cathode is a metal or metallic oxide or a combination of a metal and a metallic oxide.

6. The emitter of claim **2**, wherein the critical distance is 0.005 to 0.060 inches.

7. The emitter of claim **2**, comprising a plurality of anodes separated at the critical distance from a plurality of cathodes.

8. A method for oxygenating a non-native habitat for temporarily keeping aquatic animals, comprising:

inserting the emitter of claim **2** into the aqueous medium, the non-native habitat comprising an aquarium, a bait bucket or a live well.

9. A method for lowering the biologic oxygen demand of polluted water comprising:

passing the polluted water through a vessel containing the emitter of claim **2**.

10. A supersaturated aqueous product formed with the emitter of claim **2**, the supersaturated aqueous product having an approximately neutral pH.

11. The emitter of claim **2**, further comprising a timer control.

12. The emitter of claim **2**, wherein the anode and cathode are arranged such that the emitter assumes a funnel or pyramidal shaped emitter.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,670,495 B2
APPLICATION NO. : 12/023431
DATED : March 2, 2010
INVENTOR(S) : Senkiw

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 10, Line 55:
Delete "breading" and insert --breaking--.

Signed and Sealed this

First Day of June, 2010

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Filer:	Gregory M. Stark/John Gustav-Wrathall
Attorney Docket Number:	3406.005USR
Filed as Small Entity	

Reissue (Utility) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility Reissue Basic	2014	1	190	190
Design and utility Reissue Basic	2114	1	310	310
Design and utility Reissue Basic	2314	1	375	375
Pages:				
Claims:				
Reissue claims in excess of 20 for small	2205	45	30	1350
Independent claims reissue small	2204	2	125	250
Multiple dependent claims	2203	1	225	225

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	2700

Electronic Acknowledgement Receipt	
EFS ID:	11068096
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Gregory M. Stark/John Gustav-Wrathall
Filer Authorized By:	Gregory M. Stark
Attorney Docket Number:	3406.005USR
Receipt Date:	28-SEP-2011
Filing Date:	
Time Stamp:	14:45:32
Application Type:	Reissue (Utility)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$2700
RAM confirmation Number	1034
Deposit Account	190743
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406006USR_apln_092811.pdf	3220942 078100ec4241370d721640d942314a61f86b993a	yes	58

Multipart Description/PDF files in .zip description

Document Description	Start	End
Transmittal Reissue Application	1	1
Transmittal Reissue Application	2	2
Oath or Declaration filed	3	5
Power of Attorney	6	12
Consent of Assignee accompanying the declaration	13	18
Consent of Assignee accompanying the declaration	19	24
Preliminary Amendment	25	25
Claims	26	31
Applicant Arguments/Remarks Made in an Amendment	32	41
Specification	42	43
Drawings-only black and white line drawings	44	51
Specification	52	58

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	39650 bd46527f494427d20ef0f7169f7d3d0e97bff311	no	2

Warnings:

Information:

Total Files Size (in bytes):	3260592

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD
Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
13/247,241	09/28/2011	

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY ☒ RATE ($)	SMALL ENTITY ☒ FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
☒ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	190		N/A	
☒ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	310		N/A	
☒ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	375		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	87 minus 20 =	* 67	X $30 =	2010	OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	5 minus 3 =	* 2	X $125 =	250		X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☒ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	3135		TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 09/28/2011	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 87	Minus	** 87	= 0	X $30 =	0	OR	X $ =	
Independent (37 CFR 1.16(h))	* 5	Minus	***5	= 0	X $125 =	0	OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE	0	OR	TOTAL ADD'L FEE	

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)	OR	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/CORALIA BETANCOURT/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Document code: WFEE

United States Patent and Trademark Office
Sales Receipt for Accounting Date: 10/14/2011

CBETANCO SALE #00000001 Mailroom Dt: 09/28/2011 190743 13247241
01 FC : 2205 660.00 DA

Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Filer:	Gregory M. Stark/John Gustav-Wrathall
Attorney Docket Number:	3406.005USR
Filed as Small Entity	

Reissue (Utility) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility Reissue Basic	2014	1	190	190
Design and utility Reissue Basic	2114	1	310	310
Design and utility Reissue Basic	2314	1	375	375
Pages:				
Claims:				
Reissue claims in excess of 20 for small	2205	45	30	1350
Independent claims reissue small	2204	2	125	250
Multiple dependent claims	2203	1	225	225

Void date: 09/29/2011 SDIRETA1
09/29/2011 INTEFSW 00001034 190743 13247241
06 FC:2203 225.00 CR

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
13/247,241	09/28/2011	1797	2475	3406.005USR	65	5

CONFIRMATION NO. 1737

21186
SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

FILING RECEIPT

OC000000050175225

Date Mailed: 10/04/2011

Receipt is acknowledged of this reissue patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

James Andrew Senkiw, Minneapolise, MN;

Assignment For Published Patent Application

Oxygenator Water Technologies, Inc D/B/A Water D.O.G Works, Orono, MN

Power of Attorney: The patent practitioners associated with Customer Number 21186

Domestic Priority data as claimed by applicant

This application is a REI of 12/023,431 01/31/2008 PAT 7,670,495
which is a DIV of 10/732,326 12/10/2003 PAT 7,396,441
which is a CIP of 10/372,017 02/21/2003 PAT 6,689,262
which claims benefit of 60/358,534 02/22/2002

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****

Title

FLOW-THROUGH OXYGENATOR

Preliminary Class

210

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Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as

set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

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NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:

Title: Combined Re-issue/reexam of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	N/A
Examiner:	Unknown	Group Art Unit:	1797
Customer No.:	21186	Confirmation No.:	1737

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Status Inquiry (1 pg.)

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By: /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

S/N 13/247,241 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Oxygenator Water Technologies, Inc.	Examiner: Unknown
Serial No.:	13/247,241	Group Art Unit: 1797
Filed:	September 28, 2011	Docket: 3406.005USR
Title:	Combined Re-issue/reexam of U.S. Patent No. 7,670,495	

STATUS INQUIRY

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The above-identified patent application was filed on September 28, 2011. Applicant's last communication from the Patent Office was the Filing Receipt dated October 4, 2011.

Kindly inform us as to the status of this application, directing such notice to the attention of the below-signed attorney for Applicants.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 373-6900

Date June 1, 2012

By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

Electronic Acknowledgement Receipt	
EFS ID:	12918532
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Gregory M. Stark/John Gustav-Wrathall
Filer Authorized By:	Gregory M. Stark
Attorney Docket Number:	3406.005USR
Receipt Date:	01-JUN-2012
Filing Date:	28-SEP-2011
Time Stamp:	17:55:19
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406005usr_stat_060112.pdf	66981 dc700db34e5c3c50041fdd0bd3e4bb9378dbe277	yes	2

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Miscellaneous Incoming Letter	2	2
Warnings:			
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	Total Files Size (in bytes):	66981	

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

S/N 13/247,241 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	James Andrew Senkiw	Examiner: Unknown
Serial No.:	13/247,241	Group Art Unit: 1797
Filed:	September 28, 2011	Docket No.: 3406.005USR
Customer No.: 21186		Confirmation No.: 1737
Title:	Re-issue of U.S. Patent No. 7,670,495	

SPECIAL STATUS UNDER MPEP SECTION 1442

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

This application constitutes a re-issue of U.S. Patent No. 7,670,495. This re-issue application was filed September 28, 2011.

According to private communications between the paralegal for the undersigned attorney and officials at the U.S. PTO, this re-issue application was classified as secret under M.P.E.P §120, secrecy order. As a result, information about this application under public and private PAIR was not available. Only after several discussions between this law firm and officials of the PTO did the PTO realize that the secrecy classification of this re-issue application was in error. Those discussions are marked under PTO case no. 1-215326741

The gist of the discussion with the PTO was that the subject matter of this re-issue application cannot be secret because the underlying U.S. patent is already in the public record.

Subsequent to the PTO's reclassification of this re-issue application to ordinary re-issue status, this law firm submitted a status inquiry dated June 1, 2012. The PTO response was that a first office action would be issued in 16 months, in other words, on or about October 2013. Another status inquiry recently made through private PAIR confirmed this pendency.

M.P.E.P. §1442 specifies that "all reissue applications are take up 'special' and remain 'special' even through applicant does not respond promptly." The erroneous "secrecy" action

by the PTO, however, has delayed a prompt examination of this re-issue application. In effect, the PTO has not considered this re-issue application to fall under the "special" category for examination. Waiting more than two (2) years for a first office action on a re-issue application that officially is to have "special" status is puzzling to say the least.

Applicant respectfully requests that the PTO make every effort to promptly and speedily examine this re-issue application. Applicant desires to reach a successful conclusion of the examination of this re-issue application so that Applicant can take steps to enforce its re-issued patent. In light of the PTO misjudgment about the secrecy of the subject matter, Applicant asks the PTO to make every effort to rectify the situation. Such efforts can best be demonstrated by affording a prompt, speedy, special-status examination.

CONCLUSION

Applicant respectfully requests a speedy examination and submits that the claims are in condition for allowance. Notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's representative at (612) 373-6939 to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account 19-0743.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 373-6939

Date September 26, 2012 By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

Electronic Acknowledgement Receipt	
EFS ID:	13855088
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Gregory M. Stark/John Gustav-Wrathall
Filer Authorized By:	Gregory M. Stark
Attorney Docket Number:	3406.005USR
Receipt Date:	27-SEP-2012
Filing Date:	28-SEP-2011
Time Stamp:	15:14:42
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406005usr_requ_092712.pdf	85701 96cdf1e3b11dc7f756ca5856e19c1f51ba015d03	yes	3

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Petition for review by the Office of Petitions.	2	3
Warnings:			
Information:			
	Total Files Size (in bytes):	85701	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:

Title: Re-issue of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	N/A
Examiner:	Unknown	Group Art Unit:	1797
Customer No.:	21186	Confirmation No.:	1737

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Request for Special Status (2 pgs.)

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By: /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/247,241	09/28/2011	James Andrew Senkiw	3406.005USR	1737

21186 7590 03/06/2013

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER	
ALLEN, CAMERON J	
ART UNIT	PAPER NUMBER
1774	

NOTIFICATION DATE	DELIVERY MODE
03/06/2013	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

uspto@slwip.com
SLW@blackhillsip.com

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No.	Applicant(s)	
	13/247,241	SENKIW, JAMES ANDREW	
	Examiner	Art Unit	
	CAMERON J. ALLEN	1774	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 September 2011*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1-49* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☒ Claim(s) *1* is/are allowed.

7)☒ Claim(s) *2-7 and 9-49* is/are rejected.

8)☒ Claim(s) *8* is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *28 September 2011* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

U.S. Patent and Trademark Office
PTOL-326 (Rev. 09-12) **Office Action Summary** Part of Paper No./Mail Date 20130115

JA1060

DETAILED ACTION

Claim Rejections - 35 USC § 251

Claims 19, 20, 23-25, 33, 34, 36, 37, 38 and 43-49 are rejected under 35 U.S.C. 251 as being based upon new matter added to the patent for which reissue is sought. The added material which is not supported by the prior patent is as follows:

The specification does not disclose wherein the anode and cathode sets are disposed inside each other or wherein the anodes and cathodes are concentric.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(a):
(a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), first paragraph:
The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 19, 20, 23-25, 33, 34, 36, 37, 38 and 43-49 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably

convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention. The applicant does not point out support for the amendments and some limitations cannot be found in the original specification. Specifically, the specification does not disclose wherein the anode and cathode sets are disposed inside each other or wherein the anodes and cathodes are concentric. Therefore the claims have been amended to contain new matter.

The following is a quotation of 35 U.S.C. 112(b):

(B) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 29 and 39 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

The claims fail to further limit the claim by providing a structural difference from the claim from which it depends. Generation of micro-bubbles which are incapable of breaking surface tension of an aqueous medium is not positively

recited structure in the apparatus claims and therefore makes the claims indefinite.

Claims 2 and 7 recite the term “critical distance" which fails to narrow the claim in any way and is vague and therefore indefinite. It is unclear what the critical distance is intended to achieve or its intended function of the emitter. Therefore it is impossible to determine the scope of the claims and the claims is therefore indefinite.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 2, 3, 5, 7, 9, 10, 13- 17, 21, 22, 26, 27, 29- 32, 35, and 39-42, are rejected under 35 U.S.C. 102(b) as being anticipated by Murrell U.S. Patent 5,049,252.

With respect to claims 2, 3, 5, 7, 13, 16, 17, 21, 22, 26, 27, 29, 30, 32, 35, and 39-42 the Murrell reference seems to discloses (Claim 1) a device and a method of using the device wherein a flow is introduced that contains electrodes (anode and cathode 104 and 103 and 101) that form a grid pattern separated by a distance of 23mm or .09 inches (Column 7 line 53- column 8 line 2 and Figure 5a) made from the metal aluminum (relevant to claim 21) (Column 5 lines 55-

68). The electrodes may be in the form of, rods, tubes, mesh or net connected to a power source (Column 6 lines 21-29). It produces micro bubbles of oxygen. Murrell indicates that electrode number, spacing, surface area, form, material of construction, configuration, and voltage and current output as well as conductivity of the water being treated all may vary widely (column 5, lines 56-62, column 4, lines 8-15, etc.). The reference further discloses the use of insulating spacer 112 and washer 114(Column 10 lines 8-28 relevant for claim 16).

Generation of micro-bubbles which are incapable of breaking surface tension of an aqueous medium is not positively recited structure in the apparatus claim and would be a function of flow rates, temperatures, liquid viscosity, voltage or current output of the electrodes etc., and not just of electrode spacing.

With respect to claims 9 and 10 the claims contain language drawn to inherent results of using the device disclosed above. Therefore the claims are anticipated above. Also the treated water can be city water which is known to have a neutral pH (Column 1 lines 7-13)

With respect to claims 14, 15, and 31, the Muller reference discloses that the shape of the container for the electrodes is unimportant but the shape generally may be square or rectangular or may be an upright cylinder with the electrode 2 being a pipe or similar linear electrode (Column 2 lines 25-32).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Muller as applied above further in view of Kondo U.S. Publication 2003/0091469 A1.

With respect to claim 4, the Muller reference discloses the limitation of claim 2, but does not disclose wherein the anode is platinum and iridium oxide.

The Kondo reference does disclose the use of a water treating device with anodes made of a mixture of platinum and iridium oxide (Paragraph 0056, 0096, and 0136) to enhance the production of chlorine or ozone.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller reference by making the anodes a mixture of platinum and iridium oxide, since it would provide the added benefit and expected result of enhances chlorine and or ozone production.

Claims 6, 12, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Muller U.S. Patent 5,049,252.

With respect to claims 6 and 18 the Muller reference discloses (bridge between columns 7 and 8) the electrode spacing is about 20 or 23 mm (approximately 0.07 and 0.09 inches) and further states that the spacing is not critical. The reference also states that the number size and spacing may be varied in order to obtain the most convenient or most efficient conditions. The reference also states closer spacing will increase the amount of current for a specified voltage, or alternatively a lower voltage can be used to maintain a specified current flow (Column 2 lines 22-25).

The reference does not disclose that the spacing is less than about 0.060 inches.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller reference by making the spacing less than about 0.060 inches since the reference discloses spacing adjustment modification would provide the expected result of varying the efficiency of the system.

With respect to claim 12, the Muller reference discloses that the shape of the container for the electrodes is unimportant but the shape generally may be square or rectangular or may be an upright cylinder with the electrode 2 being a pipe or similar linear electrode (Column 2 lines 25-32).

The reference does not disclose that the shape is funnel or pyramidal shaped.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller reference by making the shape funnel or

pyramidal shaped since it is known that the shape is unimportant and would be an obvious matter of design choice.

Claims 11,19, 20, 23-25, 28, 33, 34, 36, 37, and 38 rejected under 35 U.S.C. 103(a) as being unpatentable over Muller U.S. Patent 5,049,252 further in view of Field U.S. Publication 2007/0187262 A1.

With respect to claim 11, the Muller reference discloses the device of claim 2, but does not disclose the use of a timer.

The Field reference does disclose the use of a timer to control the operation (Paragraph 0162 and 0148).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller reference by using the timer to control the process, since the use would provide the added benefit of increased control and less user interaction.

With respect to claims 19, 20, 23-25, 33, 34, 36, 37, 38, and 43-49, the Muller reference discloses a flow through device/method of using the device wherein at least one anode and cathode set is arranged wherein the electrode alternate creating sets wherein the sets are positioned by the walls of the vessel.

The reference does not disclose that the electrode sets are located inside each other, or concentric.

The Field reference discloses (paragraph 0128 and figure 9a) the use of a tubular vessel containing a concentric (inner and outer) electrode with a gap of

0.02 inches for the generation of micro-bubbles therefore making a set of anode and cathodes adjacent the wall of the container and located inside each other.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller reference by making the electrodes concentric, since the use of concentric electrodes is known to solve the problem disclosed in Muller by producing the expected result of the production of micro-bubbles.

With respect to claim 28 the Muller reference does not disclose the use of a control unit that couples the power source and electrodes when water is flowing.

The Field reference does disclose (0154) the use of a similar device that uses a control unit that energizes the pump controlling the flow and the charging of the electrodes.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller reference by using a control circuit to control the pump and electrodes, since the control unit would provide the added benefit of increased control.

With respect to claims 43-49, the Muller reference discloses a method waste with oxygenated water (such as the filth contain in the solution when the solution is oxygenated comprising and a method of using the device wherein a fluid flow is introduced that contains electrodes (anode and cathode 104 and 103 and 101) that form a grid pattern separated by a distance of 23mm or .09 inches (Column 7 line 53- column 8 line 2 and Figure 5a) made from the metal aluminum (relevant to claim 21) (Column 5 lines 55-68). The electrodes may be

in the form of, rods, tubes, mesh or net connected to a power source (Column 6 lines 21-29). It produces micro bubbles of oxygen. Murrell indicates that electrode number, spacing, surface area, form, material of construction, configuration, and voltage and current output as well as conductivity of the water being treated all may vary widely (column 5, lines 56-62, column 4, lines 8-15, etc.). The reference further discloses the use of insulating spacer 112 and washer 114(Column 10 lines 8-28 relevant for claim 16).

The reference does not disclose that the electrode sets are located inside each other, or concentric.

The Field reference discloses (paragraph 0128 and figure 9a) the use of a tubular vessel containing a concentric (inner and outer) electrode with a gap of 0.02 inches for the generation of micro-bubbles therefore making a set of anode and cathodes adjacent the wall of the container and located inside each other.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller reference by making the electrodes concentric, since the use of concentric electrodes is known to solve the problem disclosed in Muller by producing the expected result of the production of micro-bubbles.

Generation of microbubbles which are incapable of breaking surface tension of an aqueous medium is not positively recited structure in the apparatus claim and would be a function of flow rates, temperatures, liquid viscosity, voltage or current output of the electrodes etc., and not just of electrode spacing.

Allowable Subject Matter

Claim 1 is allowed. Claim 8 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: The prior are does not disclose the method step of placing the emitting device in the fluid to be treated. It discloses flowing the fluid through the device using a pie system.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CAMERON J. ALLEN whose telephone number is (571)270-3164. The examiner can normally be reached on M-Th 9-7pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Griffin Walter can be reached on 571-272-1447. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

CJA
1/16/2013

/Joseph W. Drodge/

Primary Examiner, Art Unit 1778

Notice of References Cited	Application/Control No. 13/247,241	Applicant(s)/Patent Under Reexamination SENKIW, JAMES ANDREW	
	Examiner CAMERON J. ALLEN	Art Unit 1774	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,049,252	09-1991	Murrell, Wilfred A.	204/268
*	B	US-2007/0187262	08-2007	Field et al.	205/742
*	C	US-2003/0091469	05-2003	Kondo et al.	422/23
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L4	3	("2007/0187262").URPN.	USPAT	ADJ	ON	2013/01/17 11:13
L6	3	("2007/0187261").URPN.	USPAT	ADJ	ON	2013/01/17 11:14
L7	189	("20010002500" | "20010034922" | "20020023847" | "20020027070" | "20020032141" | "20020038768" | "20020074237" | "20020112314" | "20020185423" | "20030001439" | "20030062068" | "20030070919" | "20030102270" | "20030159230" | "20030159231" | "20030159233" | "20030164306" | "20030213505" | "20040011665" | "20040012913" | "20040037737" | "20040042201" | "20040069611" | "20040094432" | "20040112763" | "20040166019" | "20040168933" | "20040226123" | "20040250323" | "20040256247" | "20050103644" | "20050121334" | "20050126928" | "20050136520" | "20050139239" | "20050139465" | "20050139808" | "20050194261" | "20050244556" | "20060037869" | "20060054205" | "20060076248" | "20060162735" | "20060169575" | "20060231503" | "20060263240" | "20060272120" | "20060280664" | "20070009376" | "20070023273" | "20070037267" | "20070141434" | "20070170072" | "20070186367" | "20070186368" | "20070186369" | "20070186954" | "20070186957" | "20070186958" | "20070187261" | "20070187262" | "20070187263" | "20070272549" | "20080264778" | "20080272060" | "20090008268" | "20090127128" | "20090148342" | "20090162505" | "20090184186" | "20090212132" | "20090235481" | "20100147700" | "20100181208" | "20100189805" | "20100192987" | "20100276301" | "20110121110" | "2288956" | "3725226" | "3859195" | "3897320" | "3933614" | "4018658" | "4099489" | "4105528" | "4108052" | "4121543" | "4129493" | "4154578" | "4244079" | "4324635" | "4374711" | "4405418" | "4502929" | "4574037" | "4600495" | "4630167" | "4663091").PN. OR ("4670113" | "4676882" | "4705191" | "4734176" | "4810344" | "4832230" | "4875988" | "4956071" | "5101110" | "5186860" | "5234563" | "5250161" | "5292406" | "5316646" | "5320718" | "5378339" | "5536389" | "5590439" | "5593476" | "5632870" | "5661237" | "5665212" | "5733434" | "5762779" | "5766438" | "5779891" | "5815869" | "5824200" | "5835680" | "5853562" | "5858201" | "5858202" | "5928505" | "5930105" | "5931859" | "5997717" | "6016973" | "6032655" | "6059941" | "6088211" | "6101671" | "6110353" | "6132572" | "6200434" | "6231747" | "6315886" | "6336430" | "6375827" | "6379628" | "6409895" | "6425958" | "6488016" | "6502766" | "6585827" | "6638364" | "6652719" | "6656334" | "6689262" | "6703785" | "6719891" | "6735812" | "6842940" | "6855233" | "6878287" | "6921743" | "6926819" | "6964739" | "6974561" | "6991593" | "7008523" | "7011739" | "7059013" | "7107046" | "7156962" | "7160472" | "7226542" | "7238272" | "7303300" | "7309136" | "7836543" | "7891046" | "8007654" | "8012339" | "8012340" | "8025786" | "8025787" | "8046867" | "8062499").PN. OR ("8337690").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:14
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L12	0	13/247241	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:25
L13	0	"13247241"	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:25
L14	5	"7670495"	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:25
L15	29011	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 11:59
L16	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and L15	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 11:59
L17	0	("2007/0284245").URPN.	USPAT	ADJ	ON	2013/01/17 12:08
L18	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and L15	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:08
L19	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and L15	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:09
L20	1178	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) and L15	US-PGPUB;	ADJ	ON	2013/01/17 12:09

EAST Search History

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT			
L21	751	(pyramid$2 or triang$5 or funnel or conical or cone) with(anode or cathode or electrode) and L15	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:10
L22	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and L15	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:11
L23	101	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (oxygen) and L15	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:11
L24	0	(platnium same (iridium with oxide)) same(anode or cathode or electrode) same (oxygen) and L15	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
L25	0	(platnium same (iridium with oxide)) same(anode or cathode or electrode) and L15	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
L26	38	(platinum same (iridium with oxide)) same(anode or cathode or electrode) same (oxygen) and L15	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
S1	1255	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 12:45
S2	28341	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 13:32
S3	83	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 13:33
S4	6	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 11:48
S5	28493	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 12:37
S6	48	(anode or cathode or electrode)same (inch or in or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S5	US-PGPUB;	ADJ	ON	2013/01/14 12:37

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT			
S7	6	"10372017"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 12:51
S8	15	("20020074237" | "4225401" | "4252856" | "4587001" | "5015354" | "5534143" | "5982609" | "6171469" | "6315886" | "6328875" | "6394429" | "6689262").PN. OR ("7396441").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/14 12:52
S9	12	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:02
S10	110	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:04
S11	0	("2007/0284245").URPN.	USPAT	ADJ	ON	2013/01/14 13:06
S12	3	("2007/0187262").URPN.	USPAT	ADJ	ON	2013/01/14 13:07
S13	1628	(anode or cathode or electrode)same (inch or "in.") and S5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:12
S14	28994	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:12
S15	1690	(anode or cathode or electrode)same (inch or "in.") and S14	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:12
S16	20	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:13
S17	32	(anode or cathode or electrode)same (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:16
S18	35	(anode or cathode or electrode)same6 (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:23
S19	10	(anode or cathode or electrode)same6 (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S14	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:23

EAST Search History

S20	29002	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:17
S21	12	(anode or cathode or electrode)same6 (inch or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S20	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:17
S22	12	(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S20	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:19
S23	39	("3404088" | "3479281" | "3562137" | "3619391" | "3783114" | "3816274" | "3816275" | "3817865" | "3853736" | "3898150" | "3904521" | "3920530" | "3925203" | "3944478" | "3975269" | "4012319" | "4075076" | "4189381" | "4197180" | "4202767" | "4294697" | "4311595" | "4623436" | "Re26329").PN. OR ("5049252").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/15 15:43
S24	6	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/16 07:44
S25	3	"20070102371"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/16 09:48
S26	29011	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:32
S27	3	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:32
S28	8	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:33
S29	105	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:40
S30	14	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:41
S31	83	(inner or outer or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:44
S32	2	(concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT;	ADJ	ON	2013/01/17 08:44

			USOCR; FPRS; EPO; JPO; DERWENT			
S33	2	(concentric) same6(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:47
S34	2	(concentric) same6 (anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:47

1/17/2013 1:08:35 PM
C:\Users\callen\Documents\EAST\Workspaces\13247241.wsp

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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BIB DATA SHEET

CONFIRMATION NO. 1737

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
13/247,241	09/28/2011 RULE	210	1774	3406.005USR

APPLICANTS

James Andrew Senkiw, Minneapolise, MN;

**** CONTINUING DATA ***************************

This application is a REI of 12/023,431 01/31/2008 PAT 7,670,495
which is a DIV of 10/732,326 12/10/2003 PAT 7,396,441
which is a CIP of 10/372,017 02/21/2003 PAT 6,689,262
which claims benefit of 60/358,534 02/22/2002

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☑ No Verified and Acknowledged /CAMERON J ALLEN/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		MN	8	65	5

ADDRESS

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402
UNITED STATES

TITLE

FLOW-THROUGH OXYGENATOR

FILING FEE RECEIVED		
3135	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

BIB (Rev. 05/07).

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13247241	SENKIW, JAMES ANDREW
	Examiner	Art Unit
	CAMERON J ALLEN	1774

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
210	739,746,748.01,748.16,748.15,748.17,748.19,749,757	1/16/2013	CA
422	22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308	1/16/2013	CA
204	155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2	1/16/2013	CA
205	701	1/16/2013	CA
22	192,321.7,1	1/17/2013	CA

SEARCH NOTES		
Search Notes	Date	Examiner
Google Search	1/16/2013	CA
See East Search History	1/16/2013	CA
Primary Joseph Drodge (General Assistance)	1/16/2013	CA
Inventor Search	1/16/2013	CA

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
	See East Search	1/16/2013	CA

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/247,241	09/28/2011	James Andrew Senkiw	3406.005USR	1737

21186 7590 05/23/2013

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER	
ALLEN, CAMERON J	
ART UNIT	PAPER NUMBER
1774	

NOTIFICATION DATE	DELIVERY MODE
05/23/2013	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

uspto@slwip.com
SLW@blackhillsip.com

PTOL-90A (Rev. 04/07)

Applicant-Initiated Interview Summary	**Application No.** 13/247,241	**Applicant(s)** SENKIW, JAMES ANDREW	
	Examiner CAMERON J. ALLEN	**Art Unit** 1774	

All participants (applicant, applicant's representative, PTO personnel):

(1) *CAMERON J. ALLEN*. (3)_____.

(2) *Albin Nelson*. (4)_____.

Date of Interview: *16 May 2013*.

Type: ☒ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☐ No.
If Yes, brief description: _____.

Issues Discussed ☐101 ☒112 ☒102 ☒103 ☐Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: *1-49*.

Identification of prior art discussed: *Murrell Paten 5,049,252*.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

The applicant has requested an interview to determine how to overcome the prior art. Currently the claims are drawn to an apparatus. Applicant has been advised that more structure is needed to overcome the art of record. The Examiner is unable to suggest structural changes from the instant specification that can be added at this time. It is unclear to the Examiner if these changes exist in the instant specification. Applicant is advised that structure added to the instant claims, supported by the instant specification, and not disclosed by the art of record, would help overcome the current rejections and further prosecution.

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/Joseph W. Drodge/ Primary Examiner, Art Unit 1778	

U.S. Patent and Trademark Office
PTOL-413 (Rev. 8/11/2010) **Interview Summary** Paper No. 20130517

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record
A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews
Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.
All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:
- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:
1) A brief description of the nature of any exhibit shown or any demonstration conducted,
2) an identification of the claims discussed,
3) an identification of the specific prior art discussed,
4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
5) a brief identification of the general thrust of the principal arguments presented to the examiner,
   (The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
6) a general indication of any other pertinent matters discussed, and
7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

S/N 13/247,241 **REISSUE PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	James Andrew Senkiw	Examiner: Cameron Allen	
Serial No.:	13/247,241	Group Art Unit: 1774	
Filed:	September 28, 2011	Docket No.: 3406.005USR	
Customer No.:	21186	Confirmation No.: 1737	
Title:	FLOW-THROUGH OXYGENATOR		

Re-issue of U.S. Patent No. 7,670,495

AMENDMENT & RESPONSE UNDER 37 C.F.R. § 1.111

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant submits this Amendment and Response in reply to the Office Action dated March 6, 2013.

This response is accompanied by a Petition, as well as the appropriate fee, to obtain a one-month extension of the period for responding to the Office action, thereby moving the deadline for response from June 6, 2013 to July 6, 2013 (Saturday).

IN THE CLAIMS

Please amend the claims as follows.

1. (Previously Submitted, Allowed) A flow through oxygenator comprising:
a fluid conduit having a fluid inlet and a fluid outlet fluidly connected with a conduit lumen;
an oxygen emitter for electrolytic generation of microbubbles of oxygen from an aqueous medium, the oxygen emitter including three matched sets of anodes and cathodes wherein the matched sets of anodes and cathodes are mounted to stabilizing hardware such that the oxygen emitter is positioned within the conduit lumen and each matched set resides at a 120° angle to the adjacent matched sets; and
a power source in electrical communication with the oxygen emitter.

2. (Currently Amended) An emitter system for production of oxygen [electrolytic generation of microbubbles of oxygen in an aqueous medium] comprising: an aqueous medium, an anode separated at a critical distance from a cathode, a nonconductive spacer maintaining the separation of the anode and cathode, the nonconductive spacer having a spacer thickness such that the critical distance is from 0.005 inches to 0.140 inches, and a power source producing a voltage maximum of 28.8 volts and amperage maximum of about 13 amps all in electrical communication with each other and the aqueous medium is tap water in fluid communication with the anode and cathode electrodes wherein the communication of the electrodes and the tap water results in the formation of oxygen microbubbles and nanobubbles in the tap water, the microbubbles having a bubble diameter of less than 0.0006 inches, said oxygen nanobubbles [microbubbles] being incapable of breaking the surface tension of the aqueous medium such that the microbubbles and nanobubbles remain in the tap water at least in part for a period up to several hours such that said aqueous medium is supersaturated with oxygen.

3. (Currently Amended) The emitter system of claim 2, wherein the anode is a metal or a metallic oxide or a combination of a metal and a metallic oxide.

4. (Currently Amended) The emitter system of claim 2, wherein the anode is [platinum] titanium and iridium oxide on a support.

5. (Currently Amended) The emitter system of claim 2 wherein the cathode is a metal or metallic oxide or a combination of a metal and a metallic oxide.

6. (Currently Amended) The emitter system of claim 2, wherein the critical distance is 0.005 to 0.060 inches.

7. (Currently Amended) The emitter system of claim 2, comprising a plurality of anodes separated at the critical distance from a plurality of cathodes.

8. (Currently Amended) A method for oxygenating a non-native habitat for temporarily keeping aquatic animals comprising:

[inserting] operating the emitter system of claim 2 [into] wherein the aqueous medium[,] comprises a [the] non-native habitat comprising an aquarium, a bait bucket or a live well.

9. (Currently Amended) A method for lowering the biologic oxygen demand of polluted water comprising:

passing the polluted water through a vessel containing the emitter system of claim 2.

10. (Currently Amended) A supersaturated aqueous product formed with the emitter system of claim 2, the supersaturated aqueous product having an approximately neutral pH.

11. (Currently Amended) The emitter system of claim 2, further comprising a timer control.

12. (Currently Amended) The emitter system of claim 2 wherein the anode and cathode are arranged such that the emitter system assumes a funnel or pyramidal shaped emitter system.

Please cancel claims 13 through 49.

Please add new claims 50- 67.

50. (New) An electrolysis emitter system for generation of nanobubbles of oxygen in water comprising:

a power source, an anode electrode and a cathode electrode contained in a tubular housing with an inlet and outlet and a tubular flow axis from the inlet to the outlet, and water flowing into the inlet and out of the outlet, wherein:

the anode electrode is separated at a critical distance from the cathode electrode by a nonconductive spacer maintaining the separation of the electrodes such that the critical distance is from 0.005 inches to 0.140 inches;

the power source is in electrical communication with the electrodes and produces a voltage of a maximum of about 28.3 volts and a maximum amperage of about 13 amps,

the water is in fluid communication with the electrodes, has a conductivity produced by a maximum of about 2000 ppm total dissolved solids;

the combination of the critical distance, the voltage, amperage and the water conductivity results in the formation of a suspension comprising oxygen nanobubbles in the water, the nanobubbles having a bubble diameter of less than 0.0006 inches and the nanobubbles being incapable of breaking the surface tension of the tap water so that the suspension remains at least in part for a period of up to several hours.

51. (New) An electrolysis emitter system according to claim 50 wherein the housing contains at least one anode and at least one cathode, the electrodes are tubular, are of a grid or solid design and are relatively positioned one inside the other with their long axes substantially collinear with the tubular flow axis of the housing.

52. (New) An electrolysis emitter system according to claim 50 wherein the housing has a side arm positioned at a transverse angle relative to the tubular flow axis and the electrodes are located in the side arm.

53. (New) An electrolysis emitter system according to claim 52 wherein the side arm contains a multiple number of anode and cathode electrodes and the electrodes are plate shaped.

54. (New) An electrolysis emitter system according to claim 50 wherein the water flow is up to about 12 gallons per minute.

55. (New) A method for producing an oxygenated aqueous composition comprising:

flowing water through an electrolysis emitter system comprising:

a power source, an anode electrode and a cathode electrodes contained in a tubular housing, wherein:

the anode electrode is separated at a critical distance from the cathode electrode by a nonconductive spacer maintaining the separation of the electrodes such that the critical distance is from 0.005 inches to 0.140 inches;

the power source is in electrical communication with the electrodes, produces a voltage of a maximum of about 28.3 volts and a maximum amperage of about 13 amps,

the tubular housing has an inlet and an outlet and a tubular flow axis from the inlet to the outlet;

the water flows in the inlet, out the outlet, is in fluid connection with the electrodes, has a conductivity produced by a maximum of about 2000 ppm total dissolved solids;

the combination of the critical distance, the voltage, amperage and the water conductivity results in the formation of a suspension comprising oxygen nanobubbles in the water, the nanobubbles having a bubble diameter of less than 0.0006 inches and the nanobubbles being incapable of breaking the surface tension of the water so that the suspension remains at least in part for a period of up to several hours.

56. (New) A method according to claim 55 wherein the housing contains at least one anode and at least one cathode, the electrodes are tubular, are of a grid or solid design and are relatively positioned one inside the other with their long axes substantially parallel to the tubular flow axis of the housing.

57. (New) A method according to claim 55 wherein the housing has a side arm positioned at an angle relative to the tubular flow axis and the electrodes are located in the side arm.

58. (New) A method according to claim 57 wherein the side arm contains a multiple number of anode and cathode electrodes and the electrodes are plate shaped.

59. (New) A method according to claim 55 wherein the water flow is up to about 12 gallons per minute

60. (New) A suspension of nanobubbles of oxygen in water which is suitable as an aqueous oxygenation composition, the suspension being produced by flowing water through an electrolysis emitter system comprising a power source, an anode electrode and a cathode electrode contained in a tubular housing, wherein:

the anode electrode is separated at a critical distance from the cathode electrode by a nonconductive spacer maintaining the separation of the electrodes such that the critical distance is from 0.005 inches to 0.140 inches;

the power source is in electrical communication with the electrodes, produces a voltage of a maximum of about 28.3 volts and a maximum amperage of about 13 amps,

the tubular housing has an inlet and an outlet and a tubular flow axis from the inlet to the outlet;

the water flows in the inlet, out the outlet, is in fluid connection with the electrodes, has a conductivity produced by a maximum of about 2000 ppm total dissolved solids;

the combination of the critical distance, the voltage, amperage and the water conductivity results in the formation of the suspension comprising oxygen nanobubbles in the water, the nanobubbles having a bubble diameter of less than 0.0006 inches and the nanobubbles being incapable of breaking the surface tension of the water so that the suspension remains at least in part for a period of up to several hours.

61. (New) A suspension according to claim 60 wherein the housing contains at least one anode and at least one cathode, the electrodes are tubular, are of a grid or solid design and are relatively positioned one inside the other with their long axes substantially parallel to the tubular flow axis of the housing.

62. (New) A suspension according to claim 60 wherein the housing has a side arm positioned at an angle relative to the tubular flow axis and the electrodes are located in the side arm.

63. (New) A suspension according to claim 62 wherein the side arm contains a multiple number of anode and cathode electrodes and the electrodes are plate shaped.

64. (New) A suspension according to claim 60 wherein the water flow is up to about 12 gallons per minute.

65. (New) An emitter system according to claim 50 wherein the water has a temperature no greater than about ambient temperature at the inlet and the water temperature is a factor for formation of the suspension.

66. (New) A method according to claim 55 wherein the water has a temperature no greater than about ambient temperature at the inlet and the water temperature is a factor for formation of the suspension.

67. (New) A suspension according to claim 60 wherein the water has a temperature no greater than about ambient temperature at the inlet and the water temperature is a factor for formation of the suspension.

REMARKS

Applicant presents this amendment for his reissue application in response to the Action issued March 6, 2013 and discussions with Examiner Allen during an in-person interview with the undersigned attorney on May 16, 2013. The undersigned attorney thanks Examiner Allen for his very helpful comments and for extending the time to conduct the in-person interview.

During the interview, Examiner Allen discussed the field of art relating to electrolysis devices. Examiner Allen stated that generally such devices are well-known in the art. He said that the pending claims of the current re-issue application should address how to distinguish electrolysis disclosed in the art. The distinction could be based upon the character of the oxygenated water produced and the features that produce that character as described in the specification. Incorporation of such features and product characteristics will facilitate advancing the prosecution of the application according to Examiner Allen.

Pursuant to these suggestions and comments by Examiner Allen, Applicant has incorporated a water requirement into the emitter claims thus describing an emitter system. The system includes the characteristics of the oxygenated water with nanobubbles of oxygen. Applicant has also presented method and suspension claims that incorporate these suggestions and comments. The details are set forth in the claims and explained in these remarks.

The Claims and Their Support

Original claims 1-12 and new claims 50-67 are pending in this application. Claims 13-40 have been cancelled.

No new matter is added by the amendments to claim 2 or by the new claims 50-67. The amendments to claim 2 are supported throughout the specification. Specifically, the added terms of claim 2 are supported by the following column and line numbers delineated as column: lines, e.g., for column 2, lines 64-65 the delineation is 2:64-65:

1. Nanobubbles – 2:64-65;
2. Spacer providing the critical distance of 0.005 to 0.140 inches – 3:11-13, 4:1-3, 5:4-8;
3. Power source voltage and amperage – 9:35-45 (Table III);
4. Tap water – 3:25 (watering hose);
5. Tap water in fluid communication with the emitter – 3:27-29 (anode and cathode contacting the water flow);

6. Nanobubbles being incapable of breaking the surface tension of the aqueous medium – 4:12-13;
7. Nanobubbles remain in tap water at least in part for a period up to several hours – 4:30-37.

The new claims 50-67 also do not add new matter. The independent claims reciting an emitter system (claim 50), method for producing a composition (claim 55) and a suspension of nanobubbles (claim 60) all contain the same parameters describing the water conductivity, the electrodes, the voltage, amperage, nanobubbles, arrangement of electrodes within the tubular housing. Support for these features is provided by the specification as follows:

1. Electrolysis emitter system including water – 2:63-67, 3:24-29;
2. Nanobubbles of oxygen in water – 2:63-67, 4:12-15;
3. Electrodes in a tubular housing – 3:26-29; 9:5-11;
4. Inlet and outlet and tubular flow axis from inlet to outlet – 3:24-29;
5. Flowing water – 3:24, 9:6;
6. Anode separated at critical distance from cathode, separation of 0.005 to 0.140 inches – 3:11-14, 6:4-8;
7. Power source of voltage and amperage – 9:35-45;
8. Water contacting electrodes – 3:27-29;
9. Water conductivity – 4:22-26;
10. Critical distance, voltage, amperage, conductivity produces nanobubbles of diameter less than 0.0006 inches and incapable of breaking surface tension so that suspension remains at least in part for a period up to several hours – 2:63-67, 3: 11-14, 4:27-54;
11. Electrodes are tubular, of a grid design, one inside the other with long axes substantially collinear with tubular flow axis – 3:24-31.
12. Electrodes in side arm relative to flow through tube – 3:31-33 (T model);
13. Electrodes are plate shaped – 3:29-31;
14. Water flow up to 12 gallons per minute – 9: 35-45 (Table III);
15. Method for producing an oxygenated aqueous composition – 2:63-67, 3:24-36;
16. Suspension of nanobubbles of oxygen in water – 2:63-67, 4:12-21.

Rejection of the claims Under 35 USC §251 and 35 USC §112 First Paragraph

The PTO rejected now cancelled claims 19, 20, 23-25, 33, 34, 36, 37, 38 and 43-49 as being based upon new matter. Applicant replies that these claims have been cancelled in favor of new claims 50-67. Therefore, this rejection is moot as it relates to these claims.

The reason for the new matter rejection bears discussion, however. The basis for this rejection is alleged to be the failure of the specification to disclose the anode and cathode sets are disposed inside each other or wherein the anodes and cathodes are concentric. Examiner Allen explained during the interview that the term "sets" in combination with the term "concentric" suggested a series of tube shaped electrodes of decreasing diameters so that the smallest diameter electrode is surrounded by the electrode of next larger diameter and this nesting continues with larger and larger diameter electrodes. Examiner Allen explained that this nesting of multiple electrodes was not supported by the specification but he did not have an objection to a description of an individual electrode as tubular.

In response, Applicant's attorney explained that the description at 3:24-29 characterizes a tubular electrode with an anode being positioned toward the outside of the flow-through model housing and the cathode being positioned on the inside. This passage necessarily infers that both electrodes are inside the housing because both must be in contact with water flowing through the flow-through housing. Moreover, the anode and cathode are to be separated by the critical distance which means that they cannot be randomly placed inside the housing. These features place one tubular electrode inside the other and space them apart in a relative spatial relationship determined by the critical distance. In other words, the smaller diameter electrode will fit inside the larger diameter electrode with the relative internal separation between the two being the critical distance.

In clarification of this characterization, Applicant has recited such an electrode arrangement in claims 51, 56 and 61 in which the two electrodes are placed one inside the other, the space between them being the critical distance of separation and their long axes substantially parallel to the tubular flow axis of the emitter housing. Applicant respectfully submits that this arrangement is supported by the specification and that the "new matter" rejection of the cancelled claims ought not to be applied to these new claims.

Second Rejection of Claims Under 35 USC §112, Second Paragraph

The PTO rejected claims 29 and 39 under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite. The PTO stated that these these claims failed to recite a feature of the apparatus that results in generation of microbubbles.

In response, Applicant states that the currently pending claims now recite water as a positive feature of the emitter system and recite the combination of emitter system factors needed to achieve a suspension of micro bubbles and nanobubbles in the water. Applicant respectfully submits that his new claims are not indefinite in regard to this issue.

The Rejection of Claims under 35 U.S.C. §102 and §103 in View of Murrell

The PTO has rejected claims 2, 3, 5, 7, 9, 10, 13-17, 21, 22, 26, 27, 29-32, 35, and 39-42 under 35 U.S.C. 102(b) as being anticipated by Murrell (U.S. Patent No. 5,049,252) and has rejected claims 6, 12 and 18 as obvious under 35 U.S.C. §103 over Murrell. .

Applicant responds that as to claims 13-17, 21, 22, 26, 29-32 and 39-42, the anticipation rejection is moot. These claims are cancelled.

In regard to the pending claims, the PTO has asserted that the Murrell device including electrodes and a power source used for electrolysis of water seems to be a device similar to that of Applicant. The PTO comments that generation of microbubbles that are incapable of breaking surface tension is a function of flow rates, temperature, liquid viscosity, voltage and current as well as electrode spacing. This comment follows the Examiner's discussion during the interview that electrolysis devices are well known. To distinguish from prior art electrolysis devices, the Examiner suggested that the pending claims should incorporate features for production of the microbubbles that are incapable of breaking water surface tension.

Applicant responds that the new claims provide these features. The new claims are directed to an emitter system that affirmatively incorporates water and nanobubbles suspended in the water, to a method of producing the suspension of nanobubbles in water and to such a suspension. Hence, the water and microbubbles/nanobubbles of oxygen suspended in the water are positively recited features of a system, a method and a suspension. In addition, the voltage, amperage, the separation of the electrode spacing, and the total solids in the water signifying viscosity and conductivity of the water, which can be summed by the phrase tap water, are positively recited features of this system. These features achieve the suspension of nanobubbles in water.

Murrell discloses an electrolysis apparatus that produces a flocculation result. Murrell's electrolysis produces large bubbles designed to rise to the surface of the electrolyzed water. The large bubbles cause contaminants in the water to form a floc and float to the surface of the water. Because Applicant's system, method and suspension concern production of microbubbles and nanobubbles that do not break water surface tension and do not rise to the water surface over a significant period of time, Applicant's system, method and suspension are not taught or suggested by Murrell.

Murrell describes his system as an apparatus and method of treating water for separation and removal of contaminants. He states that his method comprises:

> The steps of: introducing a quantity of untreated water into a container; passing DC or rectified AC electricity through the water by way of vertically arranged aluminum electrodes so as to treat the water causing at least some of the contaminants to rise; removing at least part of the water contaminants from the surface of the water; and removing at least part of the treated water.
> Murrell, 1:58-65.

Murrell provides further detail in his Detailed Description:

> Fig 3 shows the progress as time progresses with a dense material of coagulated contaminant deposits forming in a layer 12 on top of the water, which is a combination of fine gas bubbles and most of the contaminants including heavy contaminants. This layer 12 is formed by the action of extremely small gas bubbles attracting the contaminants and forming a floc, then floating to the surface because of gas content.
> Murrell, 4:66 – 5:5.

Murrell does not teach the size of his gas bubbles. He only says they rise to the surface. However, this distinction is more than sufficient to show that Applicant's system, method and suspension significantly differ from Murrell's teaching. Applicant's system, method and suspension produce microbubbles and nanobubbles of oxygen that remain suspended in water at least in part for a period up to several hours. This phenomenon is achieved because the bubbles are so small that they are incapable of breaking the surface tension of the water. In contrast, Murrell's bubbles rise to the surface. This action means that his bubbles are relatively large and, as Murrell states, "float to the surface." Murrell's gas bubbles break the surface tension of the water.

Murrell achieves gas bubble production by electrolysis of water. As pointed out by the Examiner during the interview, the general phenomenon of water electrolysis is not novel to Applicant, or to Murrell. Instead, details are important for differentiation of various electrolysis techniques. Thus, Murrell teaches that to produce gas bubbles that will flocculate contaminants and float to the surface of water. He uses a power source

with electrodes having a spacing of around 23 millimeters or about one inch. He teaches generally that the power delivered to the electrodes and the electrode spacing may be varied to achieve the desired result and will also depend upon the conductivity of the water. Murrell, 4:13-43. The desired result is key for Murrell. This result is the production of gas bubbles that rise to the surface of the water, in other words that break the water surface tension.

Applicant's system, method and suspension are the opposite. Applicant's micro and nanobubbles do not rise to the surface and do not break water surface tension. Applicant's claims now recite the conditions needed to produce this result, including voltage, amperage, total water solids indicating conductivity, and the electrode spacing. In particular, Applicant's electrode spacing is significantly smaller than the one ince spacing of Murrell. As Applicant states:

> Above that thickness (0.0140 inches), the power needs are higher and the oxygen bubbles formed at a higher voltage will coalesce and escape the fluid.
> Reissue patent - 5:4-10

In other words, higher voltages and higher electrode separations cause larger bubbles that will rise to the surface like Murrell's development.

Thus, Murrell does not teach or suggest Applicant's claimed system, method or suspension. In fact, Murrell leads away from Applicant's claimed system, method and suspension because Murrell teaches an apparatus and method that achieve a result diametrically opposed to Applicant's claimed invention. These diametrically opposed results are:

Murrell's development produces bubbles rising to the surface and breaking water surface tension; and

Applicant's invention produces a suspension of nanobubbles that do not rise to the surface and do not break the water surface tension.

Applicant respectfully submits therefore that his pending claims as amended and his new claims as presently presented are not anticipated or rendered obvious by Murrell. Applicant respectfully requests that the anticipation rejection and obviousness rejection over Murrell be withdrawn.

The Rejection of Claims under 35 U.S.C. §103 Over a Combination of References

The PTO has rejected certain pending claims under 35 U.S.C. 103(a) as being unpatentable over Murrell1 as applied above further in view of Kondo (U.S. Publication No. 2003/0091469) (claim 4) .

The PTO has also rejected claims 11, 19, 20, 23-25, 28, 33, 34, 36, 37, and 38 under 35 U.S.C. 103(a) as being unpatentable over Murrell (U.S. Patent No. 5,049,252) further in view of Field (U.S. Publication 2007/0187262).

The rejection based upon Murrell and Kondo uses Murrell as the primary reference. Kondo is cited only as a teaching of electrolysis anodes of platinum and iridium oxide. However, Kondo does not correct the deficiencies of Murrell as discussed above, nor does Kondo teach or suggest producing micro and nanobubbles of oxygen that do not break the surface tension of water in which the micro and nanobubbles are suspended. Applicant therefore respectfully submits that his pending claims as amended and his new claims are patentable over Murrell in view of Kondo.

With regard to the obviousness rejection based upon Murrell and Field, Applicant points out that Field is not a properly cited reference. Field's earliest filing date is the date of provisional application No 60/772,104, February 10, 2006. Even assuming *arguendo* that the continuation-in-part status of Applicant's grandparent patent, U.S Patent No. 6,689,262, does not fully support for Applicant's presently pending claims[2], Applicant's present application (SN13/247,241) is a reissue of US Patent No. 7,670,495 which in turn is a divisional of US patent No. 7,396,441 filed December 10, 2003. Consequently, the priority date of this reissue application is at least December 10, 2003 or some two and one-half years prior to the earliest filing date of the Field patent application. For this reason, the Field patent application does not qualify as proper prior art against the presently pending claims.

Applicant respectfully submits that citation of Field does not meet the requirements for properly citable prior art and Murrell does not teach or suggest Applicant's pending claims as discussed above.

Applicant respectfully requests that these obviousness rejections be withdrawn.

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1 The PTO action refers to Muller in these §103 rejections and mentions US 5,049,252. Consequently, it is believed that the reference to Muller is meant to be a reference to Murrell.

2 Applicant states, however, that his grandparent patent US 6,689,262 does provide full support for the presently pending claims.

CONCLUSION

Applicant states that there are no prior or concurrent proceedings in which U.S. Patent No. 7,670,495 is or was involved, including interferences, reissues, reexaminations, or litigations, or is or was the result of such proceedings.

Applicant respectfully submits that the previously pending claims as amended and new claims as presented are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's representative at (612) 373-6939 to facilitate prosecution of this application.

If necessary, please charge any additional fees or deficiencies, or credit any overpayments to Deposit Account No. 19-0743.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402--0938
(612) 373-6939

Date July 8, 2013

By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

Electronic Patent Application Fee Transmittal	
Application Number:	13247241
Filing Date:	28-Sep-2011
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Filer:	James Lee Shands/Chris Bartl
Attorney Docket Number:	3406.005USR
Filed as Small Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 1 month with $0 paid	2251	1	100	100

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**100**

Electronic Acknowledgement Receipt	
EFS ID:	16254136
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	James Lee Shands/Chris Bartl
Filer Authorized By:	James Lee Shands
Attorney Docket Number:	3406.005USR
Receipt Date:	08-JUL-2013
Filing Date:	28-SEP-2011
Time Stamp:	16:46:55
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$100
RAM confirmation Number	4073
Deposit Account	190743
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406005USR-OA-RESP-07-08-13.pdf	340345 66f81df94cbb4ed941a0b586196a438b4ad28d26	yes	17

Multipart Description/PDF files in .zip description

Document Description	Start	End
Miscellaneous Incoming Letter	1	1
Extension of Time	2	2
Amendment/Req. Reconsideration-After Non-Final Reject	3	3
Claims	4	9
Applicant Arguments/Remarks Made in an Amendment	10	17

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30132 37defb57f2e7727f3fd68e7ea69ab077bd7a7dc6	no	2

Warnings:

Information:

Total Files Size (in bytes):	370477

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: James Andrew Senkiw

Title: Re-issue of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	July 6, 2013 (Saturday)
Examiner:	Cameron Allen	Group Art Unit:	1774
Customer No.:	21186	Confirmation No.:	1737

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Amendment and Response under 37 C.F.R. § 1.111 (15 pgs.)
X Petition for Extension of Time (1 pg.)
X **Authorization to charge Deposit Account 19-0743 in the amount of $100.00 to cover the Extension of Time Fee.**

Please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By: /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

S/N 13/247,241 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	James Andrew Senkiw	Examiner:	Cameron Allen
Serial No.:	13/247,241	Group Art Unit:	1774
Filed:	September 28, 2011	Docket:	3406.005USR
Customer No.:	21186	Confirmation No.:	1737
Title:	Re-issue of U.S. Patent No. 7,670,495		

PETITION FOR A ONE-MONTH EXTENSION OF TIME

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In accordance with the provision of 37 C.F.R § 1.136(a), it is respectfully requested that a one-month extension of time be granted in which to respond to the Non-Final Office Action mailed March 6, 2013, said period of response being extended from June 6, 2013 to July 6, 2013 (Saturday).

Please charge Deposit Account No. 19-0743 in the amount of $100.00 to cover the required extension fee. Please charge any additional fees or credit overpayment to deposit Account No. 19-0743.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 373-6939

Date July 8, 2013 By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/247,241	Filing Date 09/28/2011	☐ To be Mailed

ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	07/08/2013	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 87	= 0	X $40 =	0
	Independent (37 CFR 1.16(h))	* 5	Minus	***5	= 0	X $210 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/PARTHENIA D. MERRILL/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/247,241	09/28/2011	James Andrew Senkiw	3406.005USR	1737

21186 7590 11/05/2013

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER	
ALLEN, CAMERON J	
ART UNIT	PAPER NUMBER
1774	

NOTIFICATION DATE	DELIVERY MODE
11/05/2013	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

uspto@slwip.com
SLW@blackhillsip.com

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 13/247,241	Applicant(s) SENKIW, JAMES ANDREW	
	Examiner /CAMERON J. ALLEN/	Art Unit 1774	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 July 2013*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1-12 and 50-67* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☒ Claim(s) *1,52,55-59,62 and 66* is/are allowed.

7)☒ Claim(s) *1-12 and 50-67* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some * c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

The present application is being examined under the pre-AIA first to invent provisions.

Response to Arguments

Claim 2 has been amended to contain new issues. The claim has been amended to disclose a nonconductive spacer, a maximum voltage and amperage, and the use of tap water. Also the claims have been amended to the limitation requiring water being supersaturated. These new issues require new rejections made in view of newly discovered reference Erickson U.S. Patent 5,389,214. This action is final necessitated by amendment. Claim 8 has been amended and no longer contains the limitation wherein the device is inserted in the aqueous medium. The claims 50-67 are new.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 2 and 8 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Claim 2 contains the phrase “remain in water” but does not disclose a chamber or channel for containing the water or limiting its flow, therefore it is unclear as to the structure in which the action occurs. Therefore the claim is indefinite.

Claim 8 contain the phrase “operating the emitter system of claim 2 wherein the aqueous medium comprises a non-native habitat comprising an aquarium, a bait bucket or a live well”. It is unclear how an aqueous medium may comprise a solid object such as a bucket, aquarium, or well. Therefore the scope of the claim is unclear and the claim is indefinite.

Perhaps applicant intended for the aqueous medium to be contained in such containers.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), first paragraph:
The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 51 and 56 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification does not disclose wherein the anode and cathode sets being tubular and are disposed inside each thereby making the anodes and cathodes concentric.

Claim Rejections - 35 U$C § 251

Claims 51 and 61are rejected under 35 U.S.C. 251 as being based upon new matter added to the patent for which reissue is sought. The added material which is not supported by the prior patent is as follows:

The specification does not disclose wherein the anode and cathode sets being tubular and are disposed inside each thereby making the anodes and cathodes concentric.

In accordance with pre-AIA 37 CFR 1.175(b)(1), for applications filed before September 16, 2012, a supplemental reissue oath/declaration must be received before this reissue application can be allowed.

Claims 1-12 and 50-67 are rejected as being based upon a defective reissue oath under 35 U.S.C. 251. See 37 CFR 1.175. The nature of the defect is set forth above.

Receipt of an appropriate supplemental oath/declaration will overcome this rejection. An example of acceptable language to be used in the supplemental oath/declaration is as follows:

“Every error in the patent which was corrected in the present reissue application, and is not covered by a prior oath/declaration submitted in this application, arose without any deceptive intention on the part of the applicant.”

See MPEP § 1414.01.

EXAMINERS NOTE:

Claim 2 has been amended to contain the new limitation of tap water. The applicant point out page 3 line 25 of the specification which discloses a watering hose. The reference is silent on what type of water the hose is attached to. Therefore, reading the claim in light of the specification, the term tap water can only mean water capable of flowing through a tap. Essentially any water is capable of flowing through a tap. There is no positive recitation of a tap, therefore the claim is only drawn to water of any type. Claiming a water hose, does not provide enough support to claim a specific type of water. A water hose may be attached and used in several different ways, and may be used to transport several types of waters. Water hoses are not known to only deliver a certain type of water. For Examination purposes, "tap water" will be any water capable of flowing through a tap, essentially any water.

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 2, 3, 5, 7, 9, 10, 50, 53, 60, 63, 65, and 67 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Murrell U.S. Patent 5,049,252, further in view of Erickson U.S. Patent 5,389,214.

With respect to claims 2, 3, 5, 7, 9, 10, 50, 53, 60 and 63, the Murrell reference discloses (Claim 1) a device and a method of using the device wherein a flow is introduced that contains electrodes (anode and cathode 104 and 103 and 101) that form a grid pattern separated by a distance of 23mm or .09 inches (Column 7 line 53- column 8 line 2 and Figure 5a) made from the metal aluminum (relevant to claim 21) (Column 5 lines 55-68). The electrodes may be in the form of, rods, tubes, mesh or net connected to a power source (Column 6 lines 21-29). It produces micro bubbles of oxygen. Murrell indicates that electrode number, spacing, surface area, form, material of construction, configuration, and voltage and current output as well as conductivity of the water being treated all may vary widely (column 5, lines 56-62, column 4, lines 8-15, etc.). The reference further discloses the use of insulating spacer 112 and washer 114(Column 10 lines 8-28 relevant for claim 16). The electrodes may be plates (Abstract).

Generation of micro-bubbles and nano-bubbles which are incapable of breaking surface tension of an aqueous medium is not positively recited structure in the apparatus claim. The claim states it is a result of the disclosed configuration. The formation of bubbles is a function of flow rates, temperatures, liquid viscosity, voltage or current output of the electrodes etc., and not just of electrode spacing. The applicant try to define some of these parameters by claiming tap water. This does not limit flow rater or temperature or pressure.

The reference further discloses (figure 10) washer and spacer combination between each plate. The washer is 1.6 mm and the space is between around 23 mm

leaving 21.4 mm or 0.084 inches. The space is insulating, meaning also nonconductive. The reference further discloses the power supply is typically capable of delivering a voltage in the region of say 4 to 40 volts at a current rating depending on the size of the apparatus typical preferred current will be 12 to 15 amps.

The reference differs in that it does not disclose the use of tap water or a tubular housing.

The Erickson reference discloses (Abstract) an electrolysis system that treat municipal water (tap water) with an anode electrode configuration wherein the spacing is 0.2 cm or .07 inches. The reference discloses a control circuit (20) that response to the resistivity of the water to provide constant and efficient treatment. The reference further discloses fluid source (12) may be water from different municipalities to range between 30 to 1400 ohm-meter (Column 5 lines 25-30). The Erickson reference further discloses (Figure 2) a tubular housing. The examiner notes the production of drinking water is the production of water with approximately a neutral pH.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Murrell reference by using tap water, since it is known in the art that using municipal (tap water) in electrolysis system provides the expected result of providing increased/further treatment to the water.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Murrell reference by using the tubular sousing shape, since the choice of a known shaped housing is an obvious matter of design choice.

With respect to claims 9 and 10 the claims contain language drawn to inherent results of using the device disclosed above. Therefore the claims are anticipated above. Also the treated water can be city water which is known to have a neutral pH (Column 1 lines 7-13)

With respect to claims 54 and 64, the claimed statement is a recitation of intended use. The claim does not further disclose additional structure that further limits it over its dependent claim.

A recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim.

With respect to claims 65, and 67, the Erickson reference does not disclose heating the inlet, so therefor it is implied that the water temperature at the ambient temperature of the environment t is in and temperature being a factor of formation of bubbles is an inherent property.

Claim 4 is rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Murrell in view of Erickson as applied above further in view of Kondo U.S. Publication 2003/0091469 A1.

With respect to claim 4, the Muller reference discloses the limitation of claim 2, but does not disclose wherein the anode is platinum and iridium oxide.

The Kondo reference does disclose the use of a water treating device with anodes made of a mixture of platinum and iridium oxide (Paragraph 0056, 0096, and 0136) to enhance the production of chlorine or ozone.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller reference by making the anodes a mixture of platinum and iridium oxide, since it would provide the added benefit and expected result of enhances chlorine and or ozone production.

Claims 6, and 12, are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Murrell in view of Erickson further in view of Muller U.S. Patent 5,049,252.

With respect to claims 6 the Muller reference discloses the limitation not taught by the previous reference which is, (bridge between columns 7 and 8) the electrode spacing is about 20 or 23 mm (approximately 0.07 and 0.09 inches) and further states that the spacing is not critical. The reference also states that the number size and spacing may be varied in order to obtain the most convenient or most efficient conditions. The reference also states closer spacing will increase the amount of current for a specified voltage, or alternatively a lower voltage can be used to maintain a specified current flow (Column 2 lines 22-25).

The reference does not disclose that the spacing is less than about 0.060 inches.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Murrell in view of Erickson reference by making the spacing less

than about 0.060 inches since the reference discloses spacing adjustment modification would provide the expected result of varying the efficiency of the system.

With respect to claim 12, the Muller reference discloses that the shape of the container for the electrodes is unimportant but the shape generally may be square or rectangular or may be an upright cylinder with the electrode 2 being a pipe or similar linear electrode (Column 2 lines 25-32).

The reference does not disclose that the shape is funnel or pyramidal shaped.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller reference by making the shape funnel or pyramidal shaped since it is known that the shape is unimportant and would be an obvious matter of design choice.

Claim 8 is rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Murrell in view of Erickson further in view of Metz U.S. Patent 5,500,131.

With respect to claim 8, the Muller in view of Erickson references disclose the generation of gas bubbles to create flocc and provide treatment to the water.

The Metz reference discloses (Abstract and Column 3 lines 60-67) a method of treat water including aquatic water including the generations of bubbles and flocc. The reference further discloses a supersaturated solution of gas bubbles can be incorporated into the flocc and thereby render the flocc less dense than the water.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller in view of Erickson references by using it on aquatic water

such as in the Metz reference, since it would provide the expected result of making the flocc less dense thereby increasing separation.

Claim 9 is rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Murrell in view of Erickson further in view of Ramirez U.S Patent 4,219,417.

With respect to claim 9, the Muller in view of Erickson references disclose the generation of gas bubbles to create flocc and provide treatment to the water.

The reference does not specifically disclose a method for lowering the biological oxygen demand

The Ramirez reference discloses the treatment of wastewater for decreasing BOD. The reference discloses that treating water including the generations of bubbles and flocc. The reference further discloses the formation electrolytic microbubbles would decrease the BOD.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller in view of Erickson references by using it to lower the BOD of waste water, since the Muller in view of Erickson references would solve the problem disclosed by Ramirez, which is the generation of bubbles that create flocc thereby providing the added benefit of increased treatment to wastewater.

Examiners note: applicant states in the specification “Contaminated water is described as having an increased biological oxygen demand (BOD)” therefore treated water has a decreased BOD.

Claims 11 is rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Murrell in view of Erickson as applied to claim 2, further in view of Field U.S. Publication 2007/0187262 A1.

With respect to claim 11, the Murrell in view of Erickson references disclose the device of claim 2, but does not disclose the use of a timer.

The Field reference does disclose the use of a timer to control the operation (Paragraph 0162 and 0148).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Muller reference by using the timer to control the process, since the use would provide the added benefit of increased control and less user interaction.

Allowable Subject Matter

As allowable subject matter has been indicated, applicant's reply must either comply with all formal requirements or specifically traverse each requirement not complied with. See 37 CFR 1.111(b) and MPEP § 707.07(a).

Claims 1, 52, 55-59, 62 and 66 would be allowable if applicant's reply complies with all formal requirements.

The following is a statement of reasons for the indication of allowable subject matter: The prior are does not disclose the method step of placing the emitting device in the fluid to be treated. The prior art discloses flowing the fluid through the device using a pipe system.

The prior are also does not disclose the method he combination of the critical distance, the voltage, amperage and the water conductivity results in the formation of a suspension comprising oxygen nanobubbles in the water, the nanobubbles having a bubble diameter of less than 0.0006 inches and the nanobubbles being incapable of breaking the surface tension of the water so that the suspension remains at least in part for a period of up to several hours.

The prior art does not suggest nor fairly disclose wherein the housing has a side arm positioned at an angle relative to the tubular flow axis and the electrodes are located in the side arm.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to /CAMERON J. ALLEN/ whose telephone number is (571)270-3164. The examiner can normally be reached on M-Th 9-7pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Griffin Walter can be reached on 571-272-1447. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Joseph W. Drodge/
Primary Examiner, Art Unit 1778

/CAMERON J. ALLEN/
Examiner
Art Unit 1774

Notice of References Cited	Application/Control No. 13/247,241	Applicant(s)/Patent Under Reexamination SENKIW, JAMES ANDREW	
	Examiner /CAMERON J. ALLEN/	Art Unit 1774	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,389,214	02-1995	Erickson et al.	205/701
*	B	US-5,500,131	03-1996	Metz, Jean-Paul	210/705
*	C	US-4,219,417	08-1980	Ramirez, Ernest R.	210/707
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L12	14	"5,049,252"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/08/28 08:34
S1	1255	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 12:45
S2	28341	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 13:32
S3	83	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 13:33
S4	6	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 11:48
S5	28493	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 12:37
S6	48	(anode or cathode or electrode)same (inch or in or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 12:37
S7	6	"10372017"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 12:51
S8	15	("20020074237" | "4225401" | "4252856" | "4587001" | "5015354" | "5534143" | "5982609" | "6171469" | "6315886" | "6328875" | "6394429" | "6689262").PN. OR ("7396441").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/14 12:52
S9	12	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:02
S10	110	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:04
S11	0	("2007/0284245").URPN.	USPAT	ADJ	ON	2013/01/14 13:06
S12	3	("2007/0187262").URPN.	USPAT	ADJ	ON	2013/01/14 13:07
S13	1628	(anode or cathode or electrode)same (inch or "in.") and S5	US-PGPUB; USPAT; USOCR; FPRS;	ADJ	ON	2013/01/14 13:12

EAST Search History

			EPO; JPO; DERWENT			
S14	28994	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:12
S15	1690	(anode or cathode or electrode)same (inch or "in.") and S14	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:12
S16	20	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:13
S17	32	(anode or cathode or electrode)same (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:16
S18	35	(anode or cathode or electrode)same6 (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:23
S19	10	(anode or cathode or electrode)same6 (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S14	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:23
S20	29002	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:17
S21	12	(anode or cathode or electrode)same6 (inch or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S20	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:17
S22	12	(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S20	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:19
S23	39	("3404088" | "3479281" | "3562137" | "3619391" | "3783114" | "3816274" | "3816275" | "3817865" | "3853736" | "3898150" | "3904521" | "3920530" | "3925203" | "3944478" | "3975269" | "4012319" | "4075076" | "4189381" | "4197180" | "4202767" | "4294697" | "4311595" | "4623436" | "Re26329").PN. OR ("5049252").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/15 15:43
S24	6	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/16 07:44
S25	3	"20070102371"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/16 09:48
S26	29011	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:32
S27	3	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	ON	2013/01/17 08:32

			DERWENT			
S28	8	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:33
S29	105	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:40
S30	14	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:41
S31	83	(inner or outer or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:44
S32	2	(concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:44
S33	2	(concentric) same6(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:47
S34	2	(concentric) same6 (anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:47
S35	3	("2007/0187262").URPN.	USPAT	ADJ	ON	2013/01/17 11:13
S36	3	("2007/0187261").URPN.	USPAT	ADJ	ON	2013/01/17 11:14
S37	189	("20010002500" | "20010034922" | "20020023847" | "20020027070" | "20020032141" | "20020038768" | "20020074237" | "20020112314" | "20020185423" | "20030001439" | "20030062068" | "20030070919" | "20030102270" | "20030159230" | "20030159231" | "20030159233" | "20030164306" | "20030213505" | "20040011665" | "20040012913" | "20040037737" | "20040042201" | "20040069611" | "20040094432" | "20040112763" | "20040166019" | "20040168933" | "20040226123" | "20040250323" | "20040256247" | "20050103644" | "20050121334" | "20050126928" | "20050136520" | "20050139239" | "20050139465" | "20050139808" | "20050194261" | "20050244556" | "20060037869" | "20060054205" | "20060076248" | "20060162735" | "20060169575" | "20060231503" | "20060263240" | "20060272120" | "20060280664" | "20070009376" | "20070023273" | "20070037267" | "20070141434" | "20070170072" | "20070186367" | "20070186368" | "20070186369" | "20070186954" | "20070186957" | "20070186958" | "20070187261" | "20070187262" | "20070187263" | "20070272549" | "20080264778" | "20080272060" | "20090008268" | "20090127128" | "20090148342" | "20090162505" | "20090184186" | "20090212132" | "20090235481" | "20100147700" | "20100181208" | "20100189805" | "20100192987" | "20100276301" | "20110121110" | "2288956" | "3725226" | "3859195" | "3897320" | "3933614" | "4018658" | "4099489" | "4105528" | "4108052" | "4121543" | "4129493" | "4154578" | "4244079" | "4324635" | "4374711" | "4405418" | "4502929" | "4574037" | "4600495" | "4630167" | "4663091").PN. OR ("4670113" | "4676882" | "4705191" | "4734176" | "4810344" | "4832230" | "4875988" | "4956071" | "5101110" | "5186860" | "5234563" | "5250161" | "5292406" | "5316646" | "5320718" | "5378339" | "5536389" | "5590439" | "5593476" | "5632870" | "5661237" | "5665212" | "5733434" | "5762779" | "5766438" | "5779891" | "5815869" | "5824200" | "5835680" | "5853562" | "5858201" | "5858202" | "5928505" | "5930105" | "5931859" | "5997717" | "6016973" | "6032655" | "6059941" | "6088211" | "6101671" | "6110353" | "6132572" | "6200434" | "6231747" | "6315886" | "6336430" | "6375827" | "6379628" | "6409895" | "6425958" | "6488016" | "6502766" | "6585827" | "6638364" | "6652719" | "6656334" | "6689262" | "6703785" | "6719891" | "6735812" | "6842940" | "6855233" | "6878287" | "6921743" | "6926819" | "6964739" | "6974561" | "6991593" | "7008523" | "7011739" | "7059013" | "7107046" | "7156962" | "7160472" | "7226542" | "7238272" | "7303300" | "7309136" | "7836543" | "7891046" | "8007654" | "8012339" | "8012340" | "8025786" | "8025787" | "8046867" | "8062499").PN. OR ("8337690").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:14
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S42	0	"13247241"	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:25
S43	5	"7670495"	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:25
S44	29011	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2	US-PGPUB; USPAT; USOCR;	ADJ	ON	2013/01/17 11:59

		or 205/701 or 22/192,321.7,1).ccls.	FPRS; EPO; JPO; DERWENT			
S45	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 11:59
S46	0	("2007/0284245").URPN.	USPAT	ADJ	ON	2013/01/17 12:08
S47	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:08
S48	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:09
S49	1178	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:09
S50	751	(pyramid$2 or triang$5 or funnel or conical or cone) with(anode or cathode or electrode) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:10
S51	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:11
S52	101	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (oxygen) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:11
S53	0	(platnium same (iridium with oxide)) same(anode or cathode or electrode) same (oxygen) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
S54	0	(platnium same (iridium with oxide)) same(anode or cathode or electrode) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
S55	38	(platinum same (iridium with oxide)) same(anode or cathode or electrode) same (oxygen) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
S56	34	"4,220,529"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/08/13 14:02
S57	8	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/08/27 08:39
S58	11	("5049252").URPN.	USPAT	ADJ	ON	2013/08/27 08:50
S59	1	"20080149485"	USPAT	ADJ	ON	2013/08/27 10:37
S60	3	"20080149485"	US-PGPUB;	ADJ	ON	2013/08/27

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			10:37
S61	135	"4761208"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2013/08/27 11:18

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13247241	SENKIW, JAMES ANDREW
	Examiner	Art Unit
	CAMERON J ALLEN	1774

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
210	739,746,748.01,748.16,748.15,748.17,748.19,749,757	1/16/2013	CA
422	22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308	1/16/2013	CA
204	155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2	1/16/2013	CA
205	701	1/16/2013	CA
22	192,321.7,1	1/17/2013	CA

SEARCH NOTES		
Search Notes	Date	Examiner
Google Search	1/16/2013	CA
See East Search History	1/16/2013	CA
Primary Joseph Drodge (General Assistance)	1/16/2013	CA
Inventor Search	1/16/2013	CA
See Updated East Search History	8/28/2013	CA

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
	See East Search	1/16/2013	CA
	See Updated East Search History	8/28/2013	CA

REQUEST FOR CONTINUED EXAMINATION (RCE) TRANSMITTAL		
	Application Number	13/247,241
	Filing Date	September 28, 2011
	First Named Inventor	James Andrew Senkiw
	Confirmation Number	1737
	Group Art Unit	1774
	Examiner Name	Cameron Allen
	Attorney Docket Number	3406.005USR
	Customer No.	21186

This is a Request for Continued Examination (RCE) under 37 C.F.R § 1.114 of the above-identified application entitled
Re-issue of U.S. Patent No. 7,670,495

1. Submission required under 37 C.F.R. § 1.114:

   X Amendment and Response Under 37 C.F.R § 1.116 (18 pages) is enclosed.

   X Signed Reissue Declaration of Inventorship (3 pgs)

2. Fees

   X Authorization to charge deposit account 19-0743 in the amount of $600.00 to pay the RCE filing fee required under 37 C.F.R. § 1.17(e).

The Commissioner is hereby authorized to charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.

By: /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

EXPEDITED PROCEDURE-EXAMINING GROUP 1774

S/N 13/247,241 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Examiner: Cameron Allen

Serial No.:	13/247,241	Group Art Unit: 1774	
Filed:	September 28, 2011	Docket No.: 3406.005USR	
Customer No.:	21186	Confirmation No.: 1737	
Title:	Re-issue of U.S. Patent No. 7,670,495		

AMENDMENT & RESPONSE UNDER 37 C.F.R. 1.116

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant submits this Amendment and Response in reply to the Final Office Action dated November 5, 2013. This response is accompanied by a Request for Continued Examination.

Applicant respectfully requests consideration of his amended claims presented herein in accordance with his Request for Continued Examination.

IN THE CLAIMS

Please amend the claims as follows.

1. (Allowed) A flow through oxygenator comprising:

a fluid conduit having a fluid inlet and a fluid outlet fluidly connected with a conduit lumen;

an oxygen emitter for electrolytic generation of microbubbles of oxygen from an aqueous medium, the oxygen emitter including three matched sets of anodes and cathodes wherein the matched sets of anodes and cathodes are mounted to stabilizing hardware such that the oxygen emitter is positioned within the conduit lumen and each matched set resides at a 120° angle to the adjacent matched sets; and

a power source in electrical communication with the oxygen emitter.

2. (Currently Amended) An emitter system ~~for production of oxygen~~ comprising:

an aqueous medium having a conductivity produced by dissolved solids so that the aqueous medium is capable of supporting plant or animal life, the aqueous medium containing oxygen microbubbles and nanobubbles having a bubble diameter of less than 50 microns and that are incapable of breaking the surface tension of the aqueous medium;

an anode separated at a critical distance from a cathode, a nonconductive spacer maintaining the separation of the anode and cathode, the nonconductive spacer having a spacer thickness such that the critical distance is from 0.005 inches to 0.140 inches,

a power source producing a voltage maximum of 28.3 volts and amperage maximum of about 13 amps, the electrodes, power source and aqueous medium all in electrical communication with each other; and,

the aqueous medium is ~~tap water~~ in fluid and electrical communication with the anode and cathode electrodes at no flow rate to a maximum flow rate of about 12 gallons per minute wherein the communication of the electrodes and the ~~tap water~~ aqueous medium results in the formation of the oxygen microbubbles and the nanobubbles in the ~~tap water~~ aqueous medium~~,~~ ~~the microbubbles having a bubble diameter of less than 0.0006 inches, said oxygen nanobubbles being incapable of breaking the surface tension of the aqueous medium such that the~~

~~microbubbles and nanobubbles remain in the tap water at least in part for a period up to several hours such that said aqueous medium is supersaturated with oxygen~~.

3. (Previously Presented) The emitter system of claim 2, wherein the anode is a metal or a metallic oxide or a combination of a metal and a metallic oxide.

4. (Previously Presented) The emitter system of claim 2, wherein the anode is titanium and iridium oxide on a support.

5. (Previously Presented) The emitter system of claim 2 wherein the cathode is a metal or metallic oxide or a combination of a metal and a metallic oxide.

6. (Previously Presented) The emitter system of claim 2, wherein the critical distance is 0.005 to 0.060 inches.

7. (Previously Presented) The emitter system of claim 2, comprising a plurality of anodes separated at the critical distance from a plurality of cathodes.

8. (Currently Amended) A method for oxygenating a non-native habitat for ~~temporarily~~ keeping aquatic animals comprising:

operating the emitter system of claim 2 by placing the electrodes in an aquarium, bait bucket or live well and ~~wherein~~ the aqueous medium comprises ~~a~~ the non-native habitat ~~comprising~~ in ~~an~~ the aquarium, ~~a~~ the bait bucket or ~~a~~ the live well.

9. (Previously Presented) A method for lowering the biologic oxygen demand of polluted water comprising:

passing the polluted water through a vessel containing the emitter system of claim 2.

10. (Previously Presented) A supersaturated aqueous product formed with the emitter system of claim 2, the supersaturated aqueous product having an approximately neutral pH.

11. (Previously Presented) The emitter system of claim 2, further comprising a timer control.

12. (Previously Presented) The emitter system of claim 2 wherein the anode and cathode are arranged such that the emitter system assumes a funnel or pyramidal shaped emitter system.

Claim 13 - 49 (Cancelled).

50. (Currently Amended) An electrolysis ~~emitter~~ system ~~for generation of~~ containing a suspension of microbubbles and nanobubbles of oxygen in water comprising:

a power source, an anode electrode and a cathode electrode contained in a tubular housing with an inlet and outlet and a tubular flow axis from the inlet to the outlet, and water flowing into the inlet and out of the outlet at a maximum flow rate of about 12 gallons per minute, wherein:

the anode electrode is separated at a critical distance from the cathode electrode ~~by a nonconductive spacer maintaining the separation of the electrodes~~ such that the critical distance is from 0.005 inches to 0.140 inches;

the power source is in electrical communication with the electrodes and produces a voltage ~~of a~~ maximum of about 28.3 volts and a maximum amperage of about 13 amps,

the water is in fluid and electrical communication with the electrodes, has a conductivity produced by ~~a maximum of about 2000 ppm total~~ the presence of dissolved solids such that the water is suitable for support of plant and/or animal life, and the water flowing out of the outlet contains the suspension of oxygen microbubbles and nanobubbles having a bubble diameter of less than 50 microns, the microbubbles and nanobubbles being incapable of breaking the surface tension of the water.

~~the combination of the critical distance, the voltage, amperage, and the water conductivity results in the formation of a suspension comprising oxygen nanobubbles in~~

~~the water, the nanobubbles having a bubble diameter of less than 0.0006 inches and the nanobubbles being incapable of breaking the surface tension of the tap water so that the suspension remains at least in part for a period of up to several hours.~~

51. (Currently Amended) An electrolysis ~~emitter~~ system according to claim 50 wherein the housing contains at least one anode and at least one cathode, the electrodes ~~are tubular~~ are of a grid or solid design and are relatively positioned in cross section along the radius of the tubular housing ~~one inside the other~~ with their long axes substantially ~~collinear~~ colinear with the tubular flow axis of the housing.

52. (Currently Amended) An electrolysis ~~emitter~~ system according to claim 50 wherein the housing has a side arm positioned at a transverse angle relative to the tubular flow axis and the electrodes are located in the side arm.

53. (Currently Amended) An electrolysis ~~emitter~~ system according to claim 52 wherein the side arm contains a multiple number of anode and cathode electrodes and the electrodes are plate shaped.

54. (Currently Amended) An electrolysis ~~emitter~~ system according to claim ~~50~~ 51 wherein ~~the water flow is up to about 12 gallons per minute~~ a multiple number of plate shaped electrodes of grid or solid design are present.

55. (Currently Amended) A method for producing an oxygenated aqueous composition comprising:

flowing water at a maximum flow rate of 12 gallons per minute through an electrolysis emitter ~~system~~ comprising an electrical power source electrically connected to an anode electrode and a cathode electrode contained in a tubular housing,

causing electricity to flow from the power source to the electrodes, and,

producing the composition comprising a suspension comprising oxygen microbubbles and nanobubbles in the water, the microbubbles and nanobubbles having a bubble diameter of

less than 50 microns and the microbubbles and nanobubbles being incapable of breaking the surface tension of the water, wherein:

the anode electrode is separated at a critical distance from the cathode ~~electrode by a nonconductive spacer maintaining the separation of the electrodes~~ such that the critical distance is from 0.005 inches to 0.140 inches;

the power source is ~~in electrical communication with the electrodes,~~ produces a voltage ~~of a~~ maximum of about 28.3 volts and a maximum amperage of about 13 amps,

the tubular housing has an inlet and an outlet and a tubular flow axis from the inlet to the outlet;

the water flows in the inlet, out the outlet, is in fluid connection with the electrodes, has a conductivity produced by [a maximum of about 2000 ppm total] the presence of dissolved solids such that the water supports plant or animal life ~~the combination of the critical distance, the voltage, amperage and the water conductivity results in the formation of a suspension comprising oxygen nanobubbles in the water, the nanobubbles having a bubble diameter of less than 0.0006 inches and the nanobubbles being incapable of breaking the surface tension of the tap water so that the suspension remains at least in part for a period of up to several hours~~.

56. (Presently Amended) A method according to claim 55 wherein the housing contains at least one anode and at least one cathode, the electrodes ~~are tubular~~, are of a grid or solid design and are relatively positioned in cross section along the radius of the tubular housing ~~one inside the other~~ with their long axes substantially parallel to the tubular water flow axis of the housing.

57. (Previously Presented) A method according to claim 55 wherein the housing has a side arm positioned at an angle relative to the tubular flow axis and the electrodes are located in the side arm.

58. (Previously Presented) A method according to claim 57 wherein the side arm contains a multiple number of anode and cathode electrodes and the electrodes are plate shaped.

59. (Currently Amended) A method according to claim ~~55~~ 56 wherein the ~~water flow is up to about 12 gallons per minute~~ a multiple number of anode and cathodes are present and are of grid or solid design.

60. (Currently Amended) A suspension of ~~nanobubbles of~~ oxygen in water which is suitable as an aqueous oxygenation composition, the suspension comprising oxygen microbubbles and nanobubbles in the water, the microbubbles and nanobubbles having a bubble diameter of less than 50 microns and the microbubbles and nanobubbles being incapable of breaking the surface tension of the water;

the suspension being produced by

flowing water through an electrolysis ~~emitter~~ system comprising a power source electrically connected to an anode electrode and a cathode electrode contained in a tubular housing,

causing electricity to flow to the electrodes, and,

producing the suspension

wherein:

the anode electrode is separated at a critical distance from the cathode electrode ~~by a nonconductive spacer maintaining the separation of the electrodes~~ such that the critical distance is from 0.005 inches to 0.140 inches;

the power source ~~is in electrical communication with the electrodes,~~ produces a voltage ~~of a~~ maximum of about 28.3 volts and a maximum amperage of about 13 amps,

the tubular housing has an inlet and an outlet and a tubular flow axis from the inlet to the outlet;

the water flows at a maximum rate of 12 gallons per minute in the inlet, out the outlet, is in fluid connection with the electrodes, has a conductivity produced by a ~~maximum of about 2000 ppm total~~ the presence of dissolved solids in the water such that the water is suitable for support of animal and/or plant life.

~~the combination of the critical distance, the voltage, amperage and the water conductivity results in the formation of the suspension comprising oxygen nanobubbles in the water, the nanobubbles having a bubble diameter of less than 0.0006 inches and the nanobubbles being incapable of breaking the surface tension of the water so that the suspension remains at least in part for a period of up to several hours.~~

61. (Currently Amended) A suspension according to claim 60 wherein the housing contains at least one anode and at least one cathode, the electrodes ~~are tubular~~, are of a grid or solid design and are relatively positioned in cross section along the radius of the tubular housing ~~one inside the other~~ with their long axes substantially parallel to the tubular water flow axis of the housing.

62. (Previously Presented) A suspension according to claim 60 wherein the housing has a side arm positioned at an angle relative to the tubular flow axis and the electrodes are located in the side arm.

63. (Plate Presented) A suspension according to claim 62 wherein the side arm contains a multiple number of anode and cathode electrodes and the electrodes are plate shaped.

64. (Currently Amended) A suspension according to claim ~~60~~ 61 wherein the tubular housing contains a multiple number of anode and cathode electrodes and the electrodes are of grid or solid design ~~wherein the water flow is up to about 12 gallons per minute.~~

65. (Currently Amended) A~~n emitter~~ system according to claim 50 wherein the water has a temperature no greater than about ambient temperature at the inlet and the water temperature is a factor for formation of the suspension.

66. (Previously Presented) A method according to claim 55 wherein the water has a temperature no greater than about ambient temperature at the inlet and the water temperature is a factor for formation of the suspension.

67. (Previously Presented) A suspension according to claim 60 wherein the water has a temperature no greater than about ambient temperature at the inlet and the water temperature is a factor for formation of the suspension.

68. (New) An emitter system according to claim 2 wherein the microbubbles and nanobubbles remain in the aqueous medium at least in part for a period up to several hours.

69. (New) An electrolysis system according to claim 50 wherein the microbubbles and nanobubbles remain in the water at least in part for a period up to several hours.

70. (New) A method according to claim 55 wherein the microbubbles and nanobubbles remain in the water at least in part for a period up to several hours.

71. (New) A suspension according to claim 60 wherein the microbubbles and nanobubbles remain in the water at least in part for a period up to several hours.

72. (New) An emitter system according to claim 68 wherein the period for which the microbubbles and nanobubbles at least in part remain in the aqueous medium is determined by containing the aqueous medium with micro and nanobubbles in a two and one half gallon aquarium reservoir container.

73. (New) An electrolysis system according to claim 69 wherein the period for which the microbubbles and nanobubbles at least in part remain in the water is determined by containing the water with microbubbles and nanobubbles in a two and one half gallon aquarium reservoir container.

74. (New) A method according to claim 70 wherein the period for which the microbubbles and nanobubbles at least in part remain in the water is determined by containing the water with microbubbles and nanobubbles in a two and one half gallon aquarium reservoir container.

75. (New) A suspension according to claim 71 wherein the period for which the microbubbles and nanobubbles at least in part remain in the water is determined by containing the water with microbubbles and nanobubbles in a two and one half gallon aquarium reservoir container.

76. (New) An emitter system according to claim 2 wherein the microbubbles and nanobubbles supersaturate the aqueous medium.

77. (New) An emitter system according to claim 2 wherein the bubble diameter of the microbubbles and nanobubbles is less than 0.0006 inches.

78. (New) An electrolysis system according to claim 50 wherein the microbubbles and nanobubbles supersaturate the water.

79. (New) An electrolysis system according to claim 50 wherein the bubble diameter of the microbubbles and nanobubbles is less than 0.0006 inches.

80. (New) A method according to claim 55 wherein the microbubbles and nanobubbles supersaturate the water.

81. (New) A method according to claim 55 wherein the bubble diameter of the microbubbles and nanobubbles is less than 0.0006 inches.

82. (New) A suspension according to claim 60 wherein the microbubbles and nanobubbles supersaturate the water.

83. (New) A suspension according to claim 60 wherein the bubble diameter of the microbubbles and nanobubbles is less than 0.0006 inches.

84. (New) An electrolysis system according to claim 50 wherein the separation of electrodes is maintained by a nonconductive spacer.

85. (New) A method according to claim 55 wherein the separation of electrodes is maintained by a nonconductive spacer.

86. (New) A suspension according to claim 60 wherein the separation of electrodes is maintained by a nonconductive spacer.

REMARKS

This Amendment is submitted in conjunction with an RCE to continue the prosecution of Applicant's reissue patent application. A supplemental Inventor's Declaration is submitted herewith. Although the inventor is currently ill and is in the Veteran's Administration Hospital in Minneapolis Minnesota, he has reviewed the amendment and signed this supplemental Declaration.

Assignee's attorney thanks Examiner Allen for his helpful comments during the PTO interview held December 11, 2013. The interview was originally scheduled for Tuesday December 10, 2013 but because of severe winter weather, the Federal Government closed all Washington D.C. facilities. Examiner Allen graciously agreed to reschedule the interview for the next day, December 11th.

During the interview, the undersigned attorney and Examiner Allen discussed support of the amended claims, differences of the claimed subject matter compared with the prior art and the need to submit a substitute Inventor's Declaration. Examiner Allen agreed that the amended claims are supported by the text of the specification and overcome the cited prior art. Examiner Allen stated that he would need to conduct an additional search but suggested that he expected that no closer art would be found.

The Claims and Their Support

Claims 1-12, 50-67 and new claims 68-86 are pending in this application. Claims 13-40 have been cancelled.

No new matter is added by the amendments to the claims.

The phrases characterizing "aqueous medium" and "water" are supported by the specification at 1:26-48; 2: 38-56; 1:62-67; 3:23-43; example 3, example 5 and example 6. Example 5 (8:4-10) discloses the use of municipal tap water from Minneapolis Minnesota to irrigate tomato plants. Example 3 (6:24-35) discloses water for use in a bait bucket or live well for support of fish. The passage at 1:62 discloses that the general process of production of oxygen and hydrogen by electrolysis of water is well-known. One of the factors for electrolysis

of water is the requirement that the water contain dissolved solids. The dissolved solids enable the water to carry the electrolysis current. These phases accordingly support the characterizing phrase "aqueous medium (or water) having a conductivity produced by dissolved solids so that the aqueous medium (or water) is capable of supporting plant or animal life."

The alternative phrase "tap water" had formerly been recited by these claims. The PTO questioned the kind of water this phrase referred to. While the specification at Example 5 (8:4-10) discloses the words "tap water" from a municipal source (Minneapolis Minnesota where the inventor lives and conducted his experiments), the descriptive phrase recited above has been used in place of tap water. The current phrase describing the water covers potable water delivered by a municipal water treatment plant in addition to well water, lake water and irrigation water. Water used to clean clothes, wash floors and water plants is included in this phrase. All of these kinds of water are suitable for supporting plant or animal life and will contain dissolved solids.

The water is also characterized being in fluid and electrical communication with the electrodes and having a maximum flow rate of 12 gallons per minute. Because the water generally can be contained in a static state such as in an aquarium, the water such as the water of claim 2 and its dependent claims can have no flow rate so that the flow rate generally can be no flow to a maximum of 12 gallons per minute. For systems, methods and suspensions for which water is affirmatively recited as flowing through a tubular housing, such as claims 50-67, 68-71, 73-75, the water has a positive flow rate through the emitter at a maximum of 12 gallons per minute.

The flow rate for the system, method and suspension recited by the claims operates per device so that the flow rate for multiple systems would be a multiple of the flow rate per device. The electrode size and other features also interact with the flow rate. A unifying feature of these parameters is the current density per electrode area as shown by Tables I and III.

The phrase describing the electrodes in a tubular housing as recited by claims 50-67, 69-71, 73-86 is supported by the specification at 2:63-3:43 as well as by Example 6. These passages disclose the tubular housing containing the electrodes. The passage at col. 2 discloses that "the anode is placed toward the outside of the tube and the cathode is placed on the inside, contacting

the water flow." This relative arrangement requires both electrodes to be inside the tube. Otherwise, no current would be produced. The phrase "placed toward the outside of the tube" accordingly means placed toward the outside of the inside surface of the tube. The electrodes are positioned inside the tube with one being close to the inside surface of the tube and the other electrode positioned closer to the center of the tube. To clarify this description, the phrase describing the position of the electrodes as " relatively positioned in cross section along the radius of the tubular housing" has been added to the appropriate claims (51, 56, 61).

The PTO questioned the characterization of the electrodes as "tubular" because this word does not appear in the specification. The specification teaches that the electrodes may be formed from alloys, metals or metal oxides co-deposited on a substrate. The cathodes and anodes may be formed on any convenient support in any desired shape or size" (2:27-31). This disclosure generally covers plates, tubes, rods, triangles, wafer stacks or in short any electrode design "determined according to the uses" (2:33). One or more pairs of electrodes can be incorporated into the emitter system. The specification teaches that "the anodes and cathodes may be in plates parallel to the long axis of the tube" (3:28-30). This phrase shows that multiple pairs may be present as plates parallel to the long axis of the tube. This disclosure establishes multiple pairs of electrode plates arranged as described above ("relatively positioned in cross section along the radius of the tubular housing"). Putting these two characterizations together results in multiple pairs of electrodes arranged in a circumferential relationship in the tubular housing. This arrangement is tantamount to tubular.

Claims 2-12 and 50-86 now include water and the oxygenated water as affirmative features. They recite an emitter system (claim 2 and its dependent claims), an electrolysis system containing a suspension of microbubbles and nanobubbles of oxygen in water (claim 50 and its dependent claims), a method for producing an oxygenated aqueous composition (claim 55 and its dependent claims) and a suspension of microbubbles and nanobubbles of oxygen in water which is suitable as an aqueous oxygenation composition (claim 60 and its dependent claims). The suspension of oxygen microbubbles and nanobubbles in water displays the characteristic that these bubbles are substantially incapable of breaking the surface tension of the water (2:63-67, 4:30-33). This phenomenon is described as making an opalescent or milky fluid

(the nanobubbles in water, 4:27-54). This phenomenon is capable of remaining for several hours when the suspension is contained in an appropriate container (4:34-37, 7:45-55). A container such as a two and one-half gallon aquarium reservoir is appropriate (7:45-55). A volume of the water having some depth is needed to maintain this suspension for such a period. If the suspension is spread as a film or layer of water on a flat surface such as a floor or other flat surface, the microbubbles and nanobubbles can escape in a short time from such films or layers of water.

One basis for the inventive aspect of the claimed subject matter is the inability of the microbubbles and nanobubbles to immediately break the surface tension of the water. This phenomenon results at least in part from their small size. This phenomenon ameliorates rapid escape of the oxygen bubbles from the suspension. This phenomenon enables the suspension microbubbles and nanobubbles in water to remain for a sufficient time to enable the oxygen to clean, oxidize, be absorbed or otherwise engage in chemical and biochemical interactions expected and known for oxygen.

Eventually, however, the microbubbles and nanobubbles will coalesce and/or escape from the aqueous suspension as discussed above. Some minor number of microbubbles and nanobubbles will also escape fairly rapidly from the suspension according to the principles of thermodynamics and entropy. This means that while the milky fluid will remain for a period of time, a minor amount of oxygen microbubbles and nanobubbles is apt to coalesce and escape during this period.

Claims 2, 50, 55 and 60 also recite a microbubble and nanobubble diameter of less than 50 microns as specified in the definitions section of the specification (3:65-4:15). The microbubble and nanobubble diameter of 0.0006 inches recited in originally issued claim 2 is now presented in claims 77, 79, 81 and 83 which depend respectively from claims 2, 50, 55 and 60. The diameter measurement of 0.0006 inches converts to about 15 microns. This bubble dimension is provided in example 2 of the specification.

As explained in the Summary of the Invention, the separation of the electrodes within a certain range is a factor for production of the microbubbles and nanobubbles. While use of a nonconductive spacer is one way to achieve this separation, the separation can be achieved in

other routine ways, see 3:1-42 and 4:42-54 of the specification. Consequently, the presence of a nonconductive spacer for achieving this separation is now recited in dependent claims 84-86.

While the specification recites the phrases "supersaturation" and "superoxygenated" as indicating the presence of the microbubbles and nanobubbles of oxygen in water, the skilled chemist recognizes that this composition involves two physical forms. One is oxygen dissolved in water to form a solution while the other is microbubbles and nanobubbles of oxygen suspended in water to form an aerosol. Hence, the "opalescent or milky fluid" (4:31-35) is a combination of a solution of oxygen dissolved water as a single liquid phase and an aerosol of oxygen microbubbles and nanobubbles suspended in water, i.e., an emulsification of two phases, gas and liquid. The terms "supersaturation" and "superoxygenated" are used according to the overall description presented by the application to cover this combination. The solution may not be supersaturated with dissolved oxygen but the overall composition will carry additional oxygen as an aerosol. Hence, an abundance of oxygen is present even though the water may not contain dissolved oxygen above its dissolution saturation point.

Rejections Under 35 USC §112

The PTO rejected claims 2 and 8 because they do not recite a chamber or channel. Claim 2 has been amended to recite a system. The system is operational in any kind of chamber including aquariums, bait buckets, tubular housings and other chambers containing either static water or flowing water. For this reason a chamber is not affirmatively recited.

Claim 8 has been amended to specify the chamber and aqueous medium.

Claims 51 and 56 have been amended to revise the description of electrodes in the tubular housing in place of tubular electrodes as discussed above.

It is submitted that the amendments of claims 2, 8, 51 and 56 overcome this §112 rejection.

Rejection Under 35 USC §251

The PTO has rejected claims 51 and 61 under § 251. It is submitted that this rejection is rendered moot by the amendments of these claims.

Rejection Under 35 USC §103

It is submitted that the claims as amended overcome the obviousness rejections over Murrell and Erickson. Murrell discloses a flocculation method to bring debris and waste in water to the surface. The method concerns generation of large bubbles of oxygen and hydrogen that immediately rise to the surface of the water and break the surface tension of the water. Murrell generates his bubbles by electrodes separated by 23 mm. This separation is almost one inch (0.9 inches).

As discussed during the interview, Murrell's electrode separation is more than ten times greater than the separation of the electrodes used according to the present invention ((0.005 to 0.140 inches). Murrell's separation will produce large bubbles which immediately rise to the surface, In contrast, the microbubbles and nanobubbles generated according to the present claims have a diameter of less than 50 microns and for the most part do not immediately rise to the surface. Instead, according to the present invention, these micro and nanobubbles form an opalescent or milky fluid and are suspended in the water.

Also as discussed during the interview, Erickson discloses an electronic filtration system. Erickson does not disclose electrolysis of water to produce oxygen and hydrogen.

The claims as amended now recite the suspension of micro and nanobubbles of oxygen in water as an affirmative element of the system, electrolysis system, method and suspension. Examiner Allen agreed with the undersigned attorney that these amendments overcame the cited prior art.

It is respectfully submitted therefore that the obviousness rejection has been overcome.

CONCLUSION

Applicant respectfully submits that the claims as amended and new claims as presented are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's representative at (612) 373-6939 to facilitate prosecution of this application.

If necessary, please charge any additional fees or deficiencies, or credit any overpayments to Deposit Account No. 19-0743.

Respectfully submitted,

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Date January 21, 2014 By /Albin J. Nelson/

Albin J. Nelson
Reg. No. 28,650

Attorney Docket No.3406.005USR

SCHWEGMAN ■ LUNDBERG ■ WOESSNER

United States Patent Application
REISSUE DECLARATION OF INVENTORSHIP

As a below named inventor I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that

I believe I am the original, first and sole inventor of the subject matter which is described and claimed in U.S. Patent No. **7,670,495** which was issued on **March 2, 2010** and of the subject matter claimed in the broadening reissue patent application Filed Herewith, which reissue patent application corresponds to U.S. Patent No. **7,670,495** the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by the amendment filed herewith.

I acknowledge the duty to disclose information which is material to the patentability of this reissue application in accordance with 37 C.F.R. § 1.56 (attached hereto).

I state pursuant to 37 C.F.R §1.175(a) that I, the Applicant, believe the original patent to be partly inoperative or invalid by reason of the patentee claiming less than the patentee had a right to claim in the patent. I believe that the errors to be relied upon as the basis for reissue are to be found in the text of the claims of the patent in that they do not encompass the full scope of Applicant's invention and unnecessarily limit that scope.

I state that every error in the patent which was and is corrected in the present reissue application and is not covered by a prior oath/declaration submitted in this application arose without any deceptive intention on my part as Applicant.

I understand that pursuant to 37 C.F.R. §3.71, the assignee, Oxygenator Water Technologies, Inc., has granted the power of attorney, for prosecuting this reissue patent application and for transacting all related business, to attorneys and agents of the firm of Schwegman, Lundberg, & Woessner, P. A., **Customer Number 21186**. I confirm and agree with this appointment.

Please direct all correspondence and all communications to **Schwegman, Lundberg & Woessner, P.A.,** at the address provided by the following customer number.

Customer Number: 21186

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of James Andrew Senkiw
Citizenship: U.S.A
Residence: Minneapolis, MN
Post Office Address: 4750 Aldrich Ave N, Minneapolis MN 55430-3529

Signature: _____ Date: 1/8/2014
James Andrew Senkiw

§ 1.56 Duty to disclose information material to patentability.

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

Electronic Patent Application Fee Transmittal	
Application Number:	13247241
Filing Date:	28-Sep-2011
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Filer:	Janet Elaine Embretson/Tara McMillen
Attorney Docket Number:	3406.005USR
Filed as Small Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Request for Continued Examination	2801	1	600	600
		Total in USD ($)		**600**

Electronic Acknowledgement Receipt	
EFS ID:	17969741
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Janet Elaine Embretson/Tara McMillen
Filer Authorized By:	Janet Elaine Embretson
Attorney Docket Number:	3406.005USR
Receipt Date:	21-JAN-2014
Filing Date:	28-SEP-2011
Time Stamp:	14:52:23
Application Type:	Utility under 35 USC 111(a)

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Submitted with Payment	yes
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Payment was successfully received in RAM	$600
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406005USr-RCE-signed.pdf	2357713 c9166e8b294aa9b5256fb0906937e5fa8ae29415	yes	22

Multipart Description/PDF files in .zip description

Document Description	Start	End
Request for Continued Examination (RCE)	1	1
Amendment Submitted/Entered with Filing of CPA/RCE	2	2
Claims	3	12
Applicant Arguments/Remarks Made in an Amendment	13	19
Oath or Declaration filed	20	22

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30466 acd0f7ae9d30f38af02f3b1126639f5c25ae7870	no	2

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Total Files Size (in bytes):	2388179

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PTO/SB/06 (09-11)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/247,241	Filing Date 09/28/2011	☐ To be Mailed

ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	01/21/2014	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 49	Minus	** 87	= 0	X $40 =	0
	Independent (37 CFR 1.16(h))	* 5	Minus	***5	= 0	X $210 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
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This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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	Application Number	13/247,241
	Filing Date	September 28, 2011
	First Named Inventor	
	Group Art Unit	1774
	Examiner Name	Cameron Allen
Sheet 1 of 2	Attorney Docket No: 3406.005USR	

US PATENT DOCUMENTS

Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document
	US-20020074237A1	6/20/2002	Takesako, Kiyoyuki, et al.
	US-20030164306A1	9/4/2003	Senkiw, James Andrew
	US-20040118701A1	6/24/2004	Senkiw, James Andrew
	US-20060150491A1	7/13/2006	Senkiw, James Andrew
	US-20080202995A1	8/28/2008	Senkiw, James Andrew
	US-4,071,447	1/31/1978	Ramirez, Ernest R
	US-4,225,401	9/30/1980	Divisek, Jiri, et al.
	US-4,252,856	2/24/1981	Sara, Raymond V
	US-4,257,352	3/24/1981	Habegger, William
	US-4,587,001	3/6/1986	Cairns, John F, et al.
	US-5,015,354	5/14/1991	Nishiki, Yoshinori, et al.
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	US-5,534,143	7/9/1996	Portier, Ralph J, et al.
	US-5,982,609	11/9/1999	Evans, D. A.
	US-6,171,469	1/9/2001	Hough, G. S, et al.
	US-6,315,886	11/13/2001	Zappi, Guillermo Daniel, et al.
	US-6,328,875	12/11/2001	Zappi, Guillermo Daniel, et al.
	US-6,394,429	3/28/2002	Ganan-Calvo, Alfonso
	US-6,524,475	2/25/2003	Herrington, Rodney E, et al.
	US-6,689,262	2/10/2004	Senkiw, James Andrew
	US-7,396,441	7/8/2008	Senkiw, James Andrew

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Examiner Initial *	Foreign Document Number	Publication Date	Name of Patentee or Applicant of cited Document	T 1
	EP-0723936A2	7/31/1996	Sano, Yoichi	
	GB-1522188A	8/23/1978		
	WO-0189997A2	11/29/2001	Vagnes, Magne	
	WO-03072507A1	9/4/2003	Snekiw, James Andrew	
	WO-9939561A1	8/12/1999	Mazzei, Angelo L	

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	"Effect of Oxygenated Water on the Growth & Biomass Development of Seedless Cucumbers and Tomato Seedlings under Greenhouse Conditions", Project Report: Seair Diffusion Systems, [Online]. Retrieved from the Internet: <URL: http://www.seair.ca/Pages/pdfs/DrMirzaReport.pdf>, (2003), 5 pgs	

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	WO-0189997A2	11/29/2001	Vagnes, Magne	
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	"Effect of Oxygenated Water on the Growth & Biomass Development of Seedless Cucumbers and Tomato Seedlings under Greenhouse Conditions", Project Report: Seair Diffusion Systems, [Online]. Retrieved from the Internet: <URL: http://www.seair.ca/Pages/pdfs/DrMirzaReport.pdf>, (2003), 5 pgs	

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(51) International Patent Classification 6 : **A01B 39/00**	**A1**	**(11) International Publication Number:** **WO 99/39561** **(43) International Publication Date:** 12 August 1999 (12.08.99)

(21) International Application Number: PCT/US99/02779

(22) International Filing Date: 9 February 1999 (09.02.99)

(30) Priority Data:
09/021,721 10 February 1998 (10.02.98) US

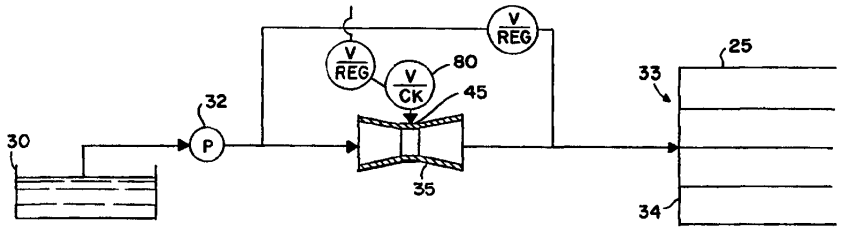
(71)(72) Applicant and Inventor: MAZZEI, Angelo, L. [US/US]; 11101 Mountain View Road, Bakersfield, CA 93307 (US).

(74) Agents: PACIULAN, Richard, J. et al.; Ladas & Parry, Suite 2100, 5670 Wilshire Boulevard, Los Angeles, CA 90036–5679 (US).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: BENEFICIATION OF SOIL WITH DISSOLVED OXYGEN FOR GROWING CROPS



(57) Abstract

An apparatus for beneficiation of soil by infusion of a treatment gas into a pressurized irrigation stream. The apparatus includes a cavitating venturi–type mixer–injector (35) with; a flow passage therethrough, an inlet and an outlet, a constricting portion of decreasing diameter, a cylindrical injector portion for injecting treatment gas into the flow passage, an increasing diameter expanding portion, an impermeable elongated conduit for receiving water and treatment gas from the mixer–injector (33) and a plurality of flow–restricting outlets disposed along the conduit wall permitting limited flow of water without substantial loss of pressure in the conduit. The mixer–injector is adapted to be connected to water source under pressure. Treatment gas will be infused into the water as it flows through the flow passage in the mixer–injector. The water will remain under super–atmospheric pressure until after it passes through the flow–restricting outlet.

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BENEFICIATION OF SOIL WITH DISSOLVED OXYGEN FOR GROWING CROPS

Field of the Invention

This invention relates to the beneficiation of soil in which a crop is grown by supplying beneficial gases to the root region.

Background of the Invention

Growing plants require water, oxygen and potentially other gases to support their life cycle. The water for most crops is derived from interstices in soil, which obtain it from rainfall or irrigation. Oxygen and other gases are obtained from the interstices, either from atmospheric gases which have migrated into the soil or from water in which the gases are dissolved. Although many gases can be beneficial to various crops, oxygen is one of the more important ones, and hence it will be dealt with specifically in this discussion, but this invention is not to be limited to the beneficial affects of oxygen only.

Generally, the concentration of oxygen or other gases in irrigation water is limited to that which is dissolved in accordance with Henry's Law. This is adequate for growth of crops. Farmers and growers of plants are fully aware of the range of wetness that a plant can tolerate. If the soil is maintained too wet for a substantial length of time, it will partially suffocate the microbial activity necessary for plant food conversion for plant uptake. It will, in effect drown. Too long a dry period will result in a lack of moisture to support plant transpiration even though there is plenty of oxygen in the soil.

Accordingly, with present practices, a plant grows best when it is alternately wetted and permitted to approach dryness. The grower attempts to provide adequate moisture and adequate oxygen to support varying transpiration ratios due to fluctuating weather conditions. Commercial intensive agricultural practice supplies oxygen as a function of the correct supply of oxygen dissolved in water, and as a function of air which is drawn into the soil as water is withdrawn from the interstitial spaces in the soil. However these sources can be quite variable. Well water, for example, tends to have less dissolved oxygen, and often contains undesirable other gases. The oxygen content in water supplied in ditches and furrows can vary depending on

water temperatures and ambient conditions.

It is an object of this invention to control and to improve the supply of oxygen to the soil, and thereby improve the growth of the plant or crop. The terms "plant" and "crop" are used interchangeably herein.

This is a fundamental problem, and efforts have been made and suggested to improve the oxygen supply by aerating irrigation water. This can indeed increase the oxygen concentration in the water, but it does not address the issue of what gas content actually reaches all plants in an area of significant size. Previous efforts have achieved some disappointingly limited improvement. For example they have not provided an optimal increase in production by weight, uniform improvement over a substantial area, or significant advancement of maturity of the plants. Their small improvement has been commercially insignificant.

This invention does provide these improvements. For example, adjacent plots of land near Bakersfield, California were planted with bell pepper plants spaced about 12-14 inches (30-36 cm) apart, along raised rows about 620 feet (200 m) long between furrows spaced about 40 inches (1 m) apart. A test plot was prepared according to this invention, as will be described below. The control plot was planted the same way, with an identical irrigation system but without the air supply of this invention. The systems were operated identically.

The results were surprisingly and unpredictably favorable. For example, it was found that the peppers reached a given point of maturity with this invention about one week sooner than peppers in the control plot. This was confirmed by observing the presence of a larger proportion of red peppers to green peppers in the test plot sooner than in the control plot. This is not a small matter. Especially at the start of a season, the earlier produce commands immediate purchase and at a premium price. This premium goes straight to the bottom line as profit. In addition an increase in production in weight of crops over the full season of about 5.6% over the control plot was noted, which also is a direct profit from this invention.

Because this invention's effects are substantially uniform over the entire field, maximum production from a plot of significant size can be anticipated. While bell peppers are given as an example of the results of using this invention, other crops may expect beneficial results, also.

As a further advantage, the plants are less stressed while growing and producing. The

average stress index of the control plot for the season was about -5.52, while the test plots had an index of about -5.76. A larger negative number is the better.

It is an object of this invention to provide a practical means to beneficiate the soil for the above purpose. By the term "beneficiate" is meant addition of a substance to improve the soil's microbial activity for better plant food uptake as a total body by the injection of air/oxygen into the vital root zone area of the plant including moisture for the intended purpose. It is not used in the sense of the addition of a chemical such as gypsum or fertilizer which is used to change the chemical constituents of the soil itself.

Brief Description of the Invention

A system to beneficiate soil according to this invention is intended to supply water and air/oxygen along with other potentially beneficial gases to the subsurface root region of the plant. It is intended to be useful over a substantial area of cropland. As an example, an area of 4.8 acres (19,400 m^2 or 1.94 ha), with rows as long as 620 (200m) feet, and from a single supply, as many as 98 of these rows can readily be treated by this invention. Treated water is to be released beneath the surface of the soil or beneath a covering for the soil such as a mulch. A plastic sheet is regarded as a mulch, although its principal purpose is to control weeds.

An example of a system for this purpose is drip irrigation in which water under system pressure is released through spaced-apart emitters directly into the subsurface soil near the plant rather than being applied to the surface or in furrows. Until the water is released from the emitter, it remains under system pressure so that it contains more dissolved oxygen and other gases than it would under atmospheric pressure, and it will also contain very small micro bubbles of oxygen and other gases such as nitrogen which have not dissolved, especially when air is used as the source of oxygen. As a consequence, when this water is released from system pressure to atmospheric pressure, the released water will then carry a dissolved amount of oxygen respective to this lower pressure, and will release in the soil the excess oxygen which was dissolved at system pressure. It will also release such gases including oxygen as may have existed in micro bubbles.

Importantly, because the system is under pressure, the quality of the mixture of oxygen-rich water and micro-bubbles remains substantially uniform throughout the entire pressured

system. Some coalescencing of the micro-bubbles can be expected, but because of their small size and dispersion, coalescence into major bubbles will not be appreciable. Therefore the water delivered through all exit orifices is substantially uniform so that every plant will be treated consistently.

It will be noted that this arrangement will compensate for the absence of oxygen from the atmosphere into the soil when covered by an impermeable plastic sheet (mulch).

According to one aspect of this invention, oxygen, oxygen containing gases such as air, and other gases beneficial for soil treatment, are injected into the water stream through a mixer-injector. The mixer-injector has a flow passage therethrough with a constricting portion, an injection portion, and an expanding portion in that order. Treatment gas enters the injection portion through an injection port.

The mixer-injector is a cavitating type which produces a reduced pressure in the injection portion, and turbulence in the injection portion. The turbulence disperses the treatment gas throughout the stream. It also reduces the size of the bubbles while it also increases their number.

According to a preferred but optional feature of this invention, the turbulence, distribution and reduction in bubble size may be improved by providing twisting vanes in the constricting portion and straightening vanes in the expanding portion. The stream from the expanding portion proceeds to a user system which may include one or more manifolds, and from there through tubing to points of discharge. It is maintained under pressure until it leaves the tubing. The rate of flow through this system and its length allow sufficient time for the oxygen or other gases to be dissolved to saturation level. The bubbles produced by this mixer-injector are small enough that they do not appreciably coalesce or rise to a surface. They tend to be discharged through the emitter along with the water.

According to a preferred but optional feature of the invention, the treatment gas is air, used for its oxygen content, as well as other potentially beneficial gases.

The above and other features of this invention will be fully understood from the following detailed description and the accompanying drawings, in which:

Brief Description of the Drawings

Fig. 1 is schematic illustration of an irrigation system according to the preferred embodiment of this invention;

Fig. 2 is a schematic cross-section of a localized region where water is being emitted;

Fig. 3 is an axial cross-section of the mixer-injector used in this invention;

Fig. 4 is a left hand end view of Fig. 3;

Fig. 5 is a right hand end view of Fig. 3; and

Fig. 6 is a longitudinal cross-section of a fragment of typical drip irrigation tubing showing an emitter suitable for use with this invention; and

Fig. 7 is a cross-section taken at line 7-7 in Fig. 6.

Detailed Description of the Invention

The object of this invention is to provide a supply of water and oxygen and/or other potentially beneficial gases to soil in the root area of a growing plant. The presently-preferred example of its use is in drip irrigation where, as shown in Fig. 2, a plant 20 is grown in soil 21 having a surface 22. For some crops, a plastic sheet 23 (regarded as a "mulch" for its weed resisting capability) or organic mulch is applied over the surface of the soil near the plant. Water supplied by this system will ordinarily be discharged about 6-10 inches (15-25 cm) below the soil surface.

As shown, a drip irrigation tubing 25 extends along a row 26. At intervals its wall is pierced by emitters 27 (Fig. 6). An emitter is simply an orifice of some kind through which water will flow from the tubing into the soil region at a regulated rate, under designated system pressure. There is a pressure drop across the emitters from system pressure, usually about 10-20 psig to atmospheric pressure.

The pressure drop at the discharge sites is of considerable importance to this invention. The reason is the higher concentration of oxygen and/or other gases that exist in the water at the higher pressure according to Henry's law. However, there is more to it than that, because frequently agricultural water supplies are not fully saturated with oxygen. In this invention, super saturation at atmospheric and system pressure can be assured, so that extra oxygen will be released from solution as the pressure drops, plus additional oxygen in the gas content of the micro bubbles that are produced. This water stream is very rich in the treatment gas.

A water source 30, such as a well, a pond, or a water main supplies water to be pressurized by a pump 32 to system pressure. If the source is a main and pressure in the main is adequate, a pump will be unnecessary. Its output is provided to a distribution system 33 which includes such conventional valves, regulators, and other controls as may be suitable. The system may include headers 34 extending along the heads of the rows 26 of crops. From the headers, flexible drip irrigation tubings 25 extend along the rows or to any desired location where the emitters 27 are to be placed. Applications other than in rows is contemplated, for example in groups of emitters around a tree, and a series of trees.

The mixer-injector 35, best shown in Fig. 3 optimally produces the desired beneficiated water. It receives water from the pump and passes it to the distribution system. Injector-mixers such as those shown in Mazzei United States patent No.4,123,800, issued October 31, 1978 are cavitating types which will in fact increase the oxygen and/or other gases content of water by drawing gas into the stream, and creating micro-bubbles. Such mixer-injectors are useful in this invention. However, the increased turbulence and shear in the illustrated mixer-injector produces smaller micro-bubbles and distributes them better, thereby providing an improved and more stable mix. Both types of mixer-injectors assure that oxygen and/or other gas saturation can be attained, and that the bubbles will be so small that they will minimally gas-out of the water in the time span generally involved in flow through systems such as these, but the mixer-injector shown in Fig. 3 provides surprisingly-improved results.

Full details of mixer-injector 35 will be found in applicant's United States Patent No. 5,863,128 issued January 26, 1999 entitled "Mixer-Injectors With Twisting and Straightening Vanes" which is incorporated herein in its entirety for its detailed showing of the construction and theory of operation of this mixer-injector. For purposes of this invention, it is sufficient to describe its basic elements.

Full details of a less-effective, but still useful mixer-injector for use with this invention will be found in the said Mazzei patent No. 4,123,800, which is incorporated herein in its entirety for its showing of such a mixer-injector. It lacks certain vanes yet to be described, which provide important advantages.

Mixer-injector 35 has a body 36 with a flow passage 37 extending from an entry port 38

to an exit port 39. An internal wall 40 forming the flow passage includes, from the entry port in this order, a cylindrical entry portion 41, a constricting portion 42, an injection portion 43, and an expanding portion 44 which terminates at exit port 39.

An injection port 45 enter the injection portion near to the constricting portion. It preferably exists as a circumferential groove 46 in the internal wall, communicating with a passage 47 that receives treatment gas to be provided to the stream in the flow passage, for example from atmospheric air. A metering valve and a check valve 80 are placed in passage 45 to provide a unidirectional flow of the correct amount of oxygen.

It is convenient to regulate the pressure and flow rate by means of establishing a flow and pressure drop through a regulator valve (which may be a flow restrictors instead) in a by-pass passage across the mixer-injector.

To this point, the mixer-injector shown in the said Mazzei '800 patent is described, and is useful. However, additional features as shown in the said Mazzei patent application provide importantly improved performance. These features are twisting vanes 48 in the constricting portion, and straightening vanes 49 in the expanding portion.

The twisting vanes 48 are provided as a group (eight is a useful number) of individual vanes with crests which as they extend along the central axis 50 of the flow passage also extend at an acute angle 51 to a plane passed through them and which includes the central axis. They rise from the entry portion into the constricting portion. They do not intersect the central axis. They give a twist to the outer region of the stream, so that when it crosses the injection port it has an increased turbulence caused by the confluence of the central "core" of the stream (which is not twisted) and the outer portion (which is twisted). This increased turbulence results in a more thorough mixing of the water and the treatment gas, and the reduction of size of the micro-bubbles, all to the advantage of this process.

Once this is attained, it is advantageous for the turbulence to be reduced, while still further shearing the micro-bubbles. This is accomplished by the group of straightening vanes 49, which extend along the expanding portion. They have crests 51 that are preferably parallel to the central axis, and are spaced apart from it. From exit port 39, the stream enters the distribution system extending to the plants.

As previously stated, emitters 27 are placed along the length of the tubing. Their characteristic is to provide for a slow bleed of water from the tubing into the subsoil. Such emitters are well-known and of several types. They constitute, in effect, a bleed valve that permits a very limited rate of flow of fluid therethrough, so the pressure in the tubing is not materially reduced, and the contents remain under pressure throughout the system.

A typical useful emitter 60 is shown formed as part of a drip irrigating tubing 61. In this emitter, the main passage 62 is formed by a wall 63. Longitudinal edges 64, 65 of the wall are overlapped to leave a restricted channel 66 between overlapped margins 67, 68. A series of inlet ports 69 is formed from passage 62 into channel 66. These ports are small and enter at numerous locations along the overlaps. The channel may further restricted by internal diverters or by serpentine passages which further reduce the rate of flow of water through channel 66. At one end of channel 66, a longitudinal slit 71 through the outer overlap releases the water from channel 66 to atmosphere.

There are other types of emitters, including small orifices through the wall of the tubing. Any emitter capable of establishing a regulated rate of fluid flow from passage 62 is acceptable.

The operation of this system will be evident from the foregoing. With the desired throughput of water per unit time decided upon, a suitably sized mixer-injector will be selected and plumbed into the system. The flow through the injection portion will establish a subatmospheric pressure in that portion which will draw treatment gas into the injection portion. The rate of flow of this gas will be adjusted by valve 55 to pass the gas at a suitable flow rate for the purposes intended.

Some treatment gas drawn into the mixer-injector will be dissolved and the remainder will be divided into micro-bubbles as described, and will flow into the system, ultimately to and through the emitters. The drip irrigation tubing is impermeable. Water and gases can leave only through the emitters (or other flow-limiting outlets, of which emitters and orifices are only two examples). The existing fluids have substantially the same water/gas mix at that point as at all other locations in the system downstream from the mixer-injector.

In a system as previously described, water was supplied to a two 2 inch mixer-injector sold by Mazzei Injector Corporation as its part No. 2081. It is constructed a shown in Fig. 3,

and as further disclosed in detail in the said Mazzei patent application. Water flowed through the system at the rate of about 260 gallons per minute and air was drawn into it at the rate of approximate 3.5 SCFM. Flow was intermittently supplied, on the average about 2 hours every 3 days and more frequently as the plant grows.

Accordingly, the soil will be beneficiated by the concurrent addition of water and treatment gas. It provides an improvement in growing conditions because it ultimately promotes a healthier plant root. Systems can be provided with the use of this invention which allow far less plant stress under varying weather conditions and watering intervals.

This invention is not to be limited by the embodiments shown in the drawings and described in the description, which are given by way of example and not of limitation, but only in accordance with the scope of the appended claims.

I CLAIM:

1. Apparatus for beneficiation of soil by infusion of a treatment gas into a pressurized irrigation stream, said apparatus comprising:

a cavitating venturi-type mixer-injector having a body with an internal wall forming a flow passage therethrough, said flow passage having a central axis, an inlet, an outlet, and between said inlet and outlet said wall forming a constricting portion of decreasing diameter, a substantially cylindrical injector portion, and an expanding portion having an increasing diameter all as they progress in that order from inlet to outlet, an injection port, said injector port receiving treatment gas from a source of gas for injection into said flow passage;

an impermeable elongated conduit having a length and a peripheral wall forming a longitudinal passage for receiving water and treatment gas from said mixer-injector;

a plurality of flow-restricting outlets disposed along the length of said conduit wall, passing through said conduit wall to permit limited flow of water from said longitudinal passage without substantial loss of pressure in said conduit;

said mixer-injector adapted to be connected to a source of water under pressure, whereby treatment gas will be infused into said water as it flows through the flow passage in the mixer injector, and said water will remain under super-atmospheric pressure until after it passes through a said flow-restricting outlet.

2. Apparatus according to claim 1 in which said flow restricting outlets are emitters either internal or external.

3. Apparatus according to claim 1 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

4. Apparatus according to any one of claims 1-3 in which a plurality of straightening vanes extend along at least a part of the expanding portion, said straightening vanes being

parallel to said central axis, but being spaced from said central axis.

5. Apparatus according to claim 4 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

6. Apparatus according to claim 5 in which said flow restricting outlets are emitters, either internal or external.

7. In combination:

crop growing soil in which a rooted crop is to be grown, said soil having a top surface; and

apparatus for beneficiation of said soil by infusion of a treatment gas into a pressurized irrigation stream of water, said apparatus comprising:

a cavitating venturi-type mixer-injector having a body with an internal wall forming a flow passage therethrough, said flow passage having a central axis, an inlet, an outlet, and between said inlet and outlet said wall forming a constricting portion of decreasing diameter, a substantially cylindrical injector portion, and an expanding portion having an increasing diameter all as they progress in that order from inlet to outlet, an injection port, said injector port receiving treatment gas from a source of gas for injection into said flow passage;

an impermeable elongated conduit having a length and a peripheral wall forming a longitudinal passage for receiving water and treatment gas from said mixer-injector;

a plurality of flow-restricting outlets disposed along the length of said conduit wall beneath said top surface, passing through said conduit wall to permit limited flow of water from said longitudinal passage without substantial loss of pressure in said conduit;

said mixer-injector adapted to be connected to a source of water under pressure, whereby treatment gas will be infused into said water as it flows through the flow passage in the mixer injector, and said water will remain under super atmospheric pressure until

after it passes through a said flow-restricting outlet.

8. Apparatus according to claim 7 in which said flow restricting outlets are emitters, either internal or external.

9. Apparatus according to claim 7 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

10. Apparatus according to any one of claims 7-9 in which a plurality of straightening vanes extend along at least a part of the expanding portion, said straightening vanes being parallel to said central axis, but being spaced from said central axis.

11. Apparatus according to claim 10 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

12. Apparatus according to claim 11 in which said flow restricting outlets are emitters either internal or external.

13. A method to improve growing conditions for crops which are grown in soil that has a top surface:

utilizing apparatus for beneficiating soil by infusion of a treatment gas into an irrigation stream of water, said apparatus comprising:

a cavitating venturi-type mixer-injector having a body with an internal wall forming a flow passage therethrough, said flow passage having a central axis, an inlet, an outlet,

and between said inlet and outlet said wall forming a constricting portion of decreasing diameter, a substantially cylindrical injector portion, and an expanding portion having an increasing diameter all as they progress in that order from inlet to outlet, an injection port, said injector port receiving treatment gas from a source of gas for injection into said flow passage;

an impermeable elongated conduit having a length and a peripheral wall forming a longitudinal passage for receiving water and treatment gas from said mixer-injector;

a plurality of flow-restricting outlets disposed along the length of said conduit wall, passing through said conduit wall to permit limited flow of water from said longitudinal passage without substantial loss of pressure in said conduit;

said mixer-injector adapted to be connected to a source of water under pressure, whereby treatment gas will be infused into said water as it flows through the flow passage in the mixer injector, and said water will remain under super atmospheric pressure until after it passes through an emitter buried in said conduit beneath said top surface;

forcing a stream of water under pressure into the entry port of said mixer injector, while admitting air into said injection portion through said injection port, thereby providing in said longitudinal passage a water stream under atmospheric pressure enriched with treatment gas, said emitters permitting limited flow of said stream into said soil.

14. The method according to claim 13 in which said flow restricting outlets are emitters.

15. The method according to claim 13 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

16. The method according to any one of claims 13-15 in which a plurality of straightening vanes extend along at least a part of the expanding portion, said straightening vanes being parallel to said central axis, but being spaced from said central axis.

17. The method according to claim 16 in which a plurality of twisting vanes extend along at least a part of said constricting portion, said vanes extending axially but at an acute angle relative to an imaginary plane which passes through them and which includes the central axis, said twisting vanes extending toward said central axis, but being spaced from said central axis.

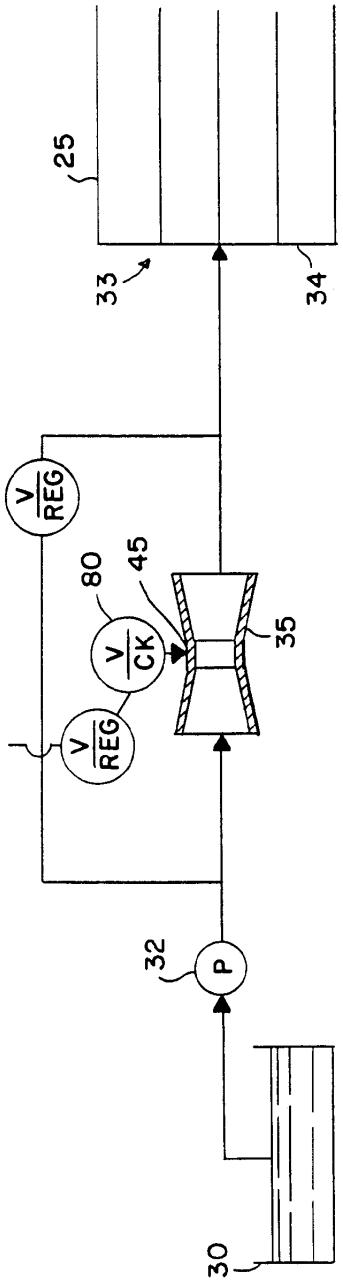

FIG. 1

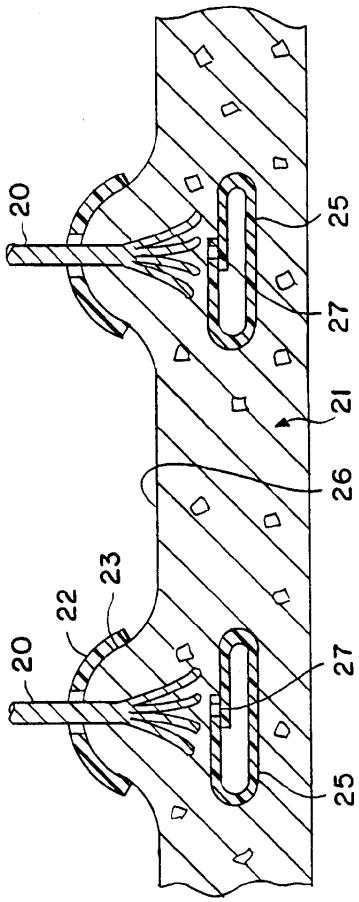

FIG. 2

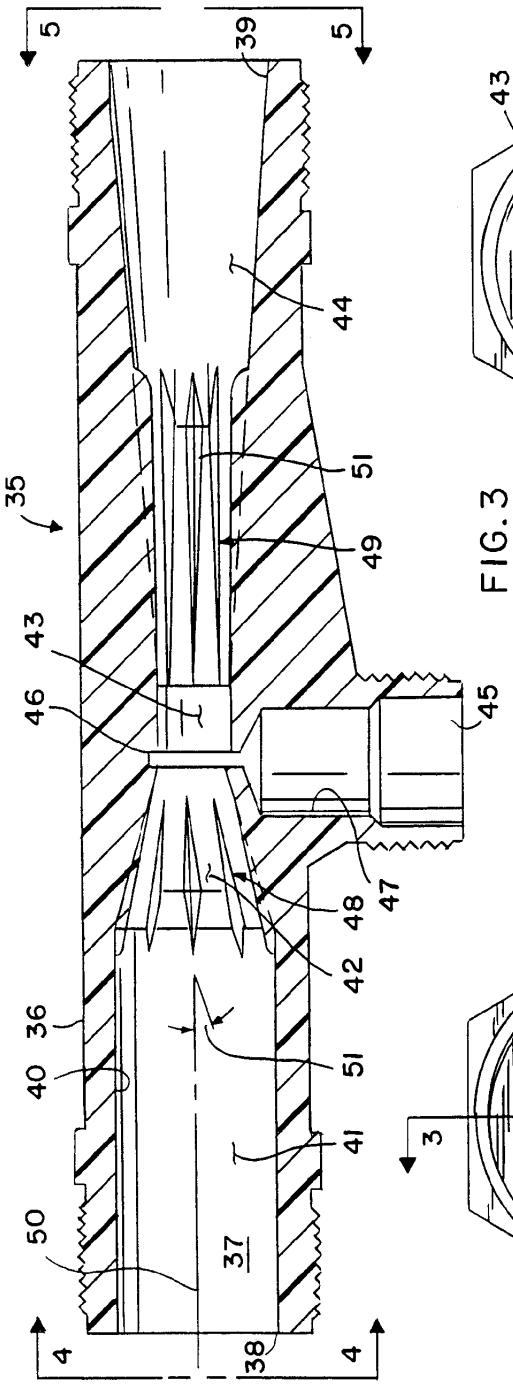

FIG. 3

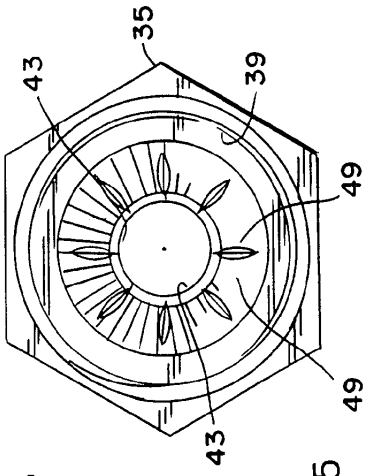

FIG. 5

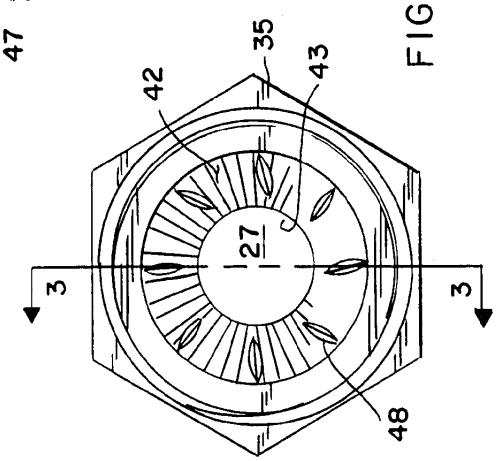

FIG. 4

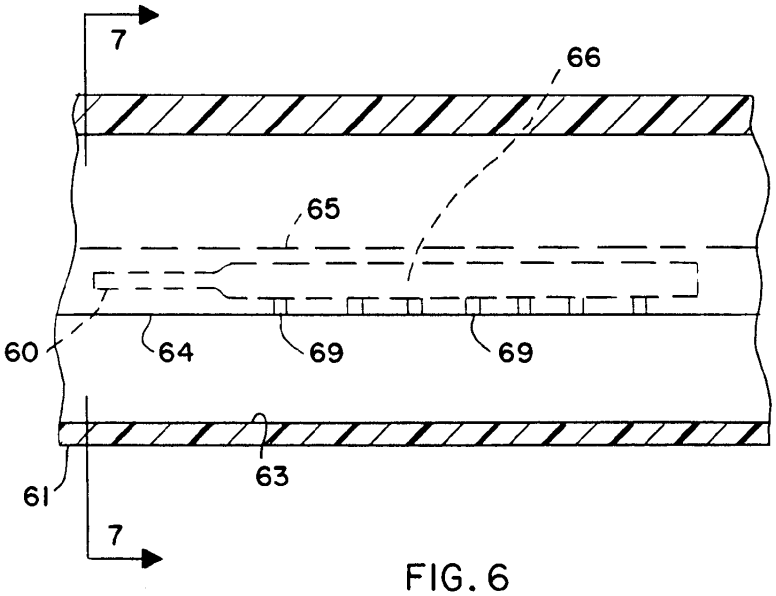

FIG. 6

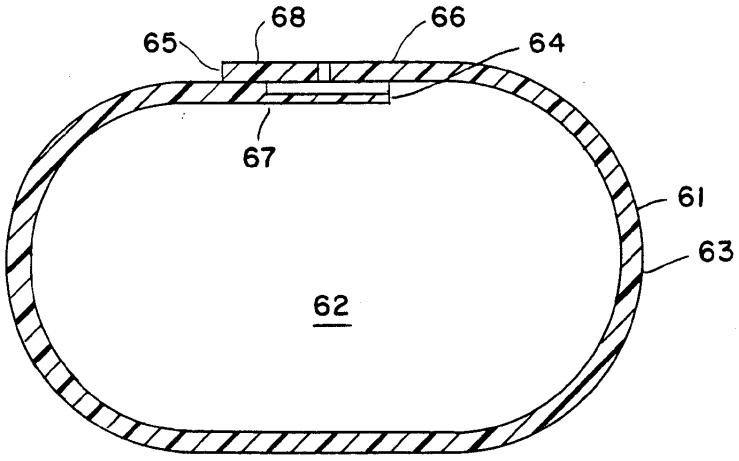

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/02779

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :A01B 39/00
US CL :47/58,1.01F
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 47/58, 48.5, 1.01F; 366/150, 163.2

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 1,200,869 A (RIFE) 10 October 1916 (10.10.16), pages 1-2 and Figures 1-2.	1,7,13 2,6,8,12,14,17
X,P	US 5,863,128 A (MAZZEI) 26 January 1999 (26.01.99), cover page Abstract and Figure 1.	3-5, 9-11, 15-17
Y	US 5,697,187 A (PERSINGER) 16 December 1997 (16.12.97), cover page Abstract and Figure-1.	1,7,13
Y	US 3,046,747 A (TIMPE) 31 July 1962 (31.07.62), see entire document, especially columns 4-6.	1,7,13 2,6,8,12,14,17

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 13 MAY 1999	Date of mailing of the international search report 02 JUL 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer FRANCIS T. PALO Telephone No. (703) 305-5595

Form PCT/ISA/210 (second sheet)(July 1992)★

JA1181

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/02779

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,123,800 A (MAZZEI) 31 October 1978 (31.10.78), cover page Abstract, columns 3-4 and Figure-1.	1,7,13

Form PCT/ISA/210 (continuation of second sheet)(July 1992)★

Electronic Acknowledgement Receipt	
EFS ID:	18316777
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Garrett M. Hall/Tikvah Kolbow
Filer Authorized By:	Garrett M. Hall
Attorney Docket Number:	3406.005USR
Receipt Date:	27-FEB-2014
Filing Date:	28-SEP-2011
Time Stamp:	10:13:37
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		13247241_IDS_02-25-14.pdf	244258 4900d05d1c34b13ec2e5616b4f2eec03f46998c5	yes	5

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Transmittal Letter	2	3
	Information Disclosure Statement (IDS) Form (SB08)	4	5

Warnings:					
Information:					
2	Foreign Reference	0001_ep0723936a2.pdf	959350 e4f967fc01ed183e3d1368480810c6c7bec6beb2	no	9
Warnings:					
Information:					
3	Foreign Reference	0002_gb1522188a.pdf	3630696 7793de029b42e2dbfe5881e8701448ef878bc43c	no	19
Warnings:					
Information:					
4	Foreign Reference	0003_wo0189997a2.pdf	1962876 6327464bd068cb792211b09da12cfa7c9973693f	no	15
Warnings:					
Information:					
5	Foreign Reference	0004_wo03072507a1.pdf	2205372 6ff6a20afa26518e0308f79c9d99359f27544d45	no	20
Warnings:					
Information:					
6	Foreign Reference	0005_wo9939561a1.pdf	2576197 86410c1040c703da43e4f30b7283ec1050fb5a1b	no	21
Warnings:					
Information:					
7	Non Patent Literature	0006_drmirzareport.pdf	2647423 c4610752c7ac06be341971764585502a1d8c952b	no	5
Warnings:					
Information:					
		Total Files Size (in bytes):	14226172		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):
Title: Re-issue of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	N/A
Examiner:	Cameron Allen	Group Art Unit:	1774
Customer No.:	21186	Confirmation No.:	1737

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Information Disclosure Statement (2 pgs.), Form 1449 (2 pgs.) Copies of Cited References (6).

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By: /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):		Examiner: Cameron Allen	
Serial No.:	13/247,241	Group Art Unit: 1774	
Filed:	September 28, 2011	Docket: 3406.005USR	
Customer No.:	21186	Confirmation No.: 1737	
Title:	Re-issue of U.S. Patent No. 7,670,495		

INFORMATION DISCLOSURE STATEMENT

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Pursuant to M.P.E.P. §1406, Applicant understands that he is not required to submit the references that were cited during the original prosecution of U.S. 7,570,495. However, Applicant wishes to endure that all such references are cited in this reissue application as M.P.E.P §1406 prescribes.

Consequently in compliance with 37 C.F.R. §§ 1.97 *et. seq*., references cited during the original prosecution of U.S. 7,570,495 are again cited on the enclosed PTO 1449 form. Applicant respectfully requests that this Information Disclosure Statement be entered and the documents listed on the attached PTO 1449 Form be confirmed as being of record. Pursuant to the provisions of MPEP 609, Applicant requests that a copy of the PTO 1449 Form, initialed as having been considered by the Examiner, be returned to the Applicant with the next official communication. Applicant understands that pursuant to M.P.E.P §1406, the Examiner has already considered these references.

Pursuant to 37 C.F.R. § 1.97(b), the Commissioner is hereby authorized to charge the required fees to Deposit Account No. 19-0743 in order to have this Information Disclosure Statement considered.

Pursuant to 37 C.F.R. § 1.98(a)(2), copies of cited U.S. Patents and Published Applications, and Non-Published Applications identifiable by USPTO Serial Number, are no longer required to be provided to the Office. Applicant acknowledges the requirement to submit copies of foreign patent documents and non-patent literature in accordance with 37 C.F.R § 1.98(a)(2). Applicant provides such copies herewith.

The Examiner is invited to contact the undersigned at the telephone number indicated if there are any questions regarding this communication.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 373-6939

Date February 25, 2014 By /Albin J. Nelson/

Albin J. Nelson
Reg. No. 28,650

AJN:tjk

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/247,241	09/28/2011	James Andrew Senkiw	3406.005USR	1737

21186 7590 03/25/2014

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER	
ALLEN, CAMERON J	
ART UNIT	PAPER NUMBER
1774	

NOTIFICATION DATE	DELIVERY MODE
03/25/2014	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

uspto@slwip.com
SLW@blackhillsip.com

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 13/247,241	Applicant(s) SENKIW, JAMES ANDREW	
	Examiner /CAMERON J. ALLEN/	Art Unit 1774	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *1/21/2014*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-12 and 50-86* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☒ Claim(s) *1, and 55-59,* is/are allowed.

7)☒ Claim(s) *2, 3,4, 5, 6, 7,8, 9-11, 12, 50, 51, 54, 60, 61, 64, 65, 67, 68, 69, 71, 72, 73, 75, 76, 77,78, 79, 82, 83, 84, are 86* is/are rejected.

8)☒ Claim(s) *52,53,62,63,66,70,74,80,81 and 85* is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

Continuation of Disposition of Claims: Claims rejected are 2, 3, 5, 6, 7, 9-11, 12, 50, 51, 54, 60, 61, 64, 65, 67, 68, 69, 71, 72, 73, 75, 76, 77, 79, 82, 83, 84, are 86 .

DETAILED ACTION

The present application is being examined under the pre-AIA first to invent provisions.

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 1/21/2014 has been entered.

Response to Arguments

Applicant's arguments with respect to 1-12 and 50-86 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection. Newly discovered reference Hough U.S. Patent 6,296,756 B1 will be used for new rejections.

Claim Objections

The newly amended claims are objected to because of the following informalities: Applicants have used strikethroughs to show deleted subject matter rather than single bracketing. Single brackets should be used to indicate newly added limitations. Also, all changes to the claims should be shown with respect to the original patent claims. Applicants are showing changes made with respect to the last version of the claims filed. All changes from the parent applicant must be continuously

tracked. Additionally, all newly added claims need to be underlined in their entirety. Indicating that the entire claim is new, not amended. No other mark-ups should be present in these claims. Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 2, 3, 5, 6, 7, 9-11, 12, 50, 51, 54, 60, 61, 64, 65, 67, 68, 69, 71, 72, 73, 75, 76, 77,78, 79, 82, 83, 84, are 86 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Hough U.S. Patent 6,296,756 B1.

With respect to claims 2, 6, 7, 11, 50, 51, 54, 60, 61, 64, 65, and 67 the Hough reference discloses (Column 3 lines 53-67) an electrolytic cell 102 may be connected in a monopolar electrolytic cell circuit operating at 3 to 12 volts DC and from 0.1 to 5 amperes or up to 50 amperes, and with the plates/solid (relevant to claims 51, 54, 61 and 64) spaced 0.030 inches apart. The electrolytic cell 102 also may include up to twenty plates (relevant to claim 7) and operating in the range of 12 to 150 volts DC and in the range of less than 1 ampere to over 5 amperes with the plates spaced 0.030 inches apart (relevant to claim 6). The electrolytic cell 102 coupled to a power supply via

a system control circuit 118. A power cord 120 provides power to the system control circuit 118. Power cord 119 outputs electronic controls and power from the system control circuit 118 directly to the electrolytic cell 102 within the housing 106. The device is used to produce drinking water which is known to be capable of supporting animal life, such as humans. The cell 102 (Column 6 lines 13-34) is energized and power is provided in step 608. This causes the water to begin oxygenation. As oxygen gas is created, bubbles are placed into the water which naturally rise. In batch operation, the flow rate is 0. The set of electrodes 104 may be oval, cylindrical or other acceptable shape. Figure 5 discloses the pitcher or tubular housing. A timer (Figure 4 relevant to claim 11) will usually be implemented within in the electronic control 122, or user control panel 126, since electronic timers are easily constructed and are well known in the art. The water is at room temperature according to column 6 lines 1-12 wherein water to be treated sits out overnight thereby coming to room temperature (relevant to claims 65 and 67).

Although the prior art does not specifically state the formation of nano bubbles and micro bubbles is does disclose it is a result of the configuration. Since the Hough reference discloses the same configuration, it is capable of providing the same results.

It is within the ordinary skill of one in the art to optimize the spacing and power supply, since it has been held that wherein the general conditions exist, it is within the ordinary skill of one in the art to find or discover the workable or optimum values.

With respect to claims 3 and 5, the reference further discloses (Claim 8) that the electrodes may be wielded together. Welding in a technique known to bond metal pieces together, therefore the electrodes are metal.

With respect to claims 9 and 10, the reference discloses that drinking water is produced which has a neutral pH after being treated in the pitcher contain the emitter system of claim 2.

Regarding claim 12, the Hough reference discloses (Figure 9B) a pyramid shaped emitter system.

Regarding claims 68, 69, and 71, the claims do not further disclose additional structure that further limits it over its dependent claim; therefore they are rejected for the same reasons.

Regarding claims 72, 73, and 75, the Hough reference discloses (Abstract) the container is from .5 to 5 gallon capacity. Therefore the device is capable of being used at the 2.5 gallon mark.

Regarding claims 77, 79, and 83, the claims do not further disclose additional structure that further limits it over its dependent claim. The claim states that the bubble size is a diameter less than 0.0006 inches. Since all of the claimed structure is present and independent claims state that the bubbles are due to the electrode gap, the device should create the bubble size for at least same reasons as applicant.

Regarding claims 76, 78, and 82, the Hough reference discloses that the saturation level is determined by the length of time the device is allowed to operate. Therefore the device is capable of saturation when given enough time.

Regarding claims 84 and 86, the Hough reference discloses spacers 108 are used to maintain the gaps. The spacers must be nonconductive to avoid shorting.

Claim 4 is rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Hough, further in view of Kondo U.S. 2003/0091469 A1.

With respect to claim 4, the Hough reference discloses the limitation of claim 2, but does not disclose wherein the anode is platinum and iridium oxide.

The Kondo reference does disclose the use of a water treating device with anodes made of a mixture of platinum and iridium oxide (Paragraph 0056, 0096, and 0136) to enhance the production of chlorine or ozone and oxygen at the cathode. The microorganisms on the surface in the treatment-object water are annihilated also by these chlorine (hypochlorous acid), ozone and active oxygen.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Hough reference by making the anodes a mixture of platinum and iridium oxide, since it would provide the added benefit and expected result of enhanced treatment and increased oxygen production.

Claim 8 is rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Hough, further in view of Mun KR 940003935.

With respect to claim 8, the art of record does not expressly disclose that the device is placed in an aquarium, bait bucket, or live well. The device is however used to

treat water and provide increased oxygen to water. It would be obvious to use the device wherein water treatment and increased oxygen is needed.

The Mun KR 940003935 reference discloses that fish in aquarium water needing water treatment and oxygen generation.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the Hough reference by using it to prepare water for fish, since it would provide the expected result of solving the problem of providing water treatment while supplying increased oxygen.

Allowable Subject Matter

As allowable subject matter has been indicated, applicant's reply must either comply with all formal requirements or specifically traverse each requirement not complied with. See 37 CFR 1.111(b) and MPEP § 707.07(a).

Claims 1, 52, 53, 55-59, 62, 63, 66, 70, 74, 80, 81, and 85 would be allowable if applicant's reply complies with all formal requirements.

The following is a statement of reasons for the indication of allowable subject matter: The prior are does not disclose the method step of placing the emitting device in the fluid to be treated. The prior art discloses flowing the fluid through the device using a pipe system.

The prior art does not suggest nor fairly disclose wherein the housing has a side arm positioned at an angle relative to the tubular flow axis and the electrodes are located in the side arm.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. 6,419,815 and PCT/JP03/12523 using US Publication 2006/0054205 A1 as a translation, 7,628,912: 5,336,399.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to /CAMERON J. ALLEN/ whose telephone number is (571)270-3164. The examiner can normally be reached on M-Th 9-7pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Griffin Walter can be reached on 571-272-1447. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JOSEPH DRODGE/
Primary Examiner, Art Unit 1778

/CAMERON J. ALLEN/
Examiner
Art Unit 1774

Notice of References Cited	Application/Control No. 13/247,241	Applicant(s)/Patent Under Reexamination SENKIW, JAMES ANDREW	
	Examiner /CAMERON J. ALLEN/	Art Unit 1774	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,419,815	07-2002	Chambers, Stephen Barrie	205/628
*	B	US-6,296,756	10-2001	Hough et al.	205/744
*	C	US-2006/0054205	03-2006	Yabe et al.	134/184
*	D	US-7,628,912	12-2009	Yamasaki et al.	210/150
*	E	US-5,336,399	08-1994	Kajisono, Takekazu	210/170.02
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N	KR940003935a1	12-1991	KR	MUN JAE-DOK	A01K63/04
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

PUB-NO: KR940003935B1
DOCUMENT-IDENTIFIER: KR 940003935 B1
TITLE: APPARATUS FOR SUPPLYING AIR OF IN THE AQUARIUM
PUBN-DATE: May 9, 1994

INVENTOR-INFORMATION:

NAME	COUNTRY
MUN JAE-DOK	KR

APPLICANT:

NAME	COUNTRY
MUN JAE DOK	KR

APPL-NO: KR 910022637 A
APPL-DATE: December 9, 1991

PRIORITY-DATA:

PRIORITY-NO	PRIORITY-APPL-DATE
KR 910022637 A	19911209

INT-CL-CURRENT:

TYPE	IPC/DATE
IPCP	A01K63/04 20060101

ABSTRACT:

The device for supplying oxygen to fish in an aquarium and purifying the water, comprises an electro magnetic wave shield device made of electro-conductive catalytic metal for resolving hydrogen peroxide into water and oxygen; an oxygen generator having opposite electrode wires (16,17) on an insulation plate (6); semiconductor power supply (4) connected with the opposite electrode wires (16,17) of the oxygen generator. The oxygen generator has wire-type electrode or plate-type electrode provided at the insulation plate (6) with upper/lower deep grooves (7,8) and shallow grooves (11,12), traverse grooves (13)(19) with the inserted subsidiary electrode wires (18),(22).

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	406	(119/263 or 210/167.21).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/07 06:10
L2	1	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and l1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:10
L3	1	("20060054205").PN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2014/02/07 06:19
L4	2417	(119/263 or 210/150,167.21).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/07 06:28
L5	6	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and l4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:28
L6	2	("2008/0264843").URPN.	USPAT	ADJ	ON	2014/02/07 06:33
L7	6806	(119/263 or 210/150,151,745,532.2,167.21,220,167.21).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/07 06:38
L8	13	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and l7	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:38
L9	9426	(119/263 or 210/150,151,745,532.2,167.21,220,167.21 or 134/56R or 435/286.6 or 417/5 or 261/26).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/07 06:40
L10	13	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and l9	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:41
L11	301	(((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and l9	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:41
L12	12	(((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and l1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:45
L13	1	(anode or cathode or electrode) and(((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and l1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:48

EAST Search History

L14	42	(anode or cathode or electrode) and(((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and l9	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:49
S1	1255	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 12:45
S2	28341	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 13:32
S3	83	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 13:33
S4	6	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 11:48
S5	28493	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 12:37
S6	48	(anode or cathode or electrode)same (inch or in or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 12:37
S7	6	"10372017"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 12:51
S8	15	("20020074237" | "4225401" | "4252856" | "4587001" | "5015354" | "5534143" | "5982609" | "6171469" | "6315886" | "6328875" | "6394429" | "6689262").PN. OR ("7396441").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/14 12:52
S9	12	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:02
S10	110	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:04
S11	0	("2007/0284245").URPN.	USPAT	ADJ	ON	2013/01/14 13:06
S12	3	("2007/0187262").URPN.	USPAT	ADJ	ON	2013/01/14 13:07
S13	1628	(anode or cathode or electrode)same (inch or "in.") and S5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:12
S14	28994	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:12
S15	1690	(anode or cathode or electrode)same (inch or "in.") and S14	US-PGPUB; USPAT; USOCR; FPRS;	ADJ	ON	2013/01/14 13:12

EAST Search History

			EPO; JPO; DERWENT			
S16	20	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:13
S17	32	(anode or cathode or electrode)same (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:16
S18	35	(anode or cathode or electrode)same6 (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:23
S19	10	(anode or cathode or electrode)same6 (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S14	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:23
S20	29002	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:17
S21	12	(anode or cathode or electrode)same6 (inch or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S20	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:17
S22	12	(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S20	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:19
S23	39	("3404088" | "3479281" | "3562137" | "3619391" | "3783114" | "3816274" | "3816275" | "3817865" | "3853736" | "3898150" | "3904521" | "3920530" | "3925203" | "3944478" | "3975269" | "4012319" | "4075076" | "4189381" | "4197180" | "4202767" | "4294697" | "4311595" | "4623436" | "Re26329").PN. OR ("5049252").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/15 15:43
S24	6	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/16 07:44
S25	3	"20070102371"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/16 09:48
S26	29011	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:32
S27	3	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:32
S28	8	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:33
S29	105	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	ON	2013/01/17 08:40

EAST Search History

			DERWENT			
S30	14	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:41
S31	83	(inner or outer or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:44
S32	2	(concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:44
S33	2	(concentric) same6(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:47
S34	2	(concentric) same6 (anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:47
S35	3	("2007/0187262").URPN.	USPAT	ADJ	ON	2013/01/17 11:13
S36	3	("2007/0187261").URPN.	USPAT	ADJ	ON	2013/01/17 11:14
S37	189	("20010002500" | "20010034922" | "20020023847" | "20020027070" | "20020032141" | "20020038768" | "20020074237" | "20020112314" | "20020185423" | "20030001439" | "20030062068" | "20030070919" | "20030102270" | "20030159230" | "20030159231" | "20030159233" | "20030164306" | "20030213505" | "20040011665" | "20040012913" | "20040037737" | "20040042201" | "20040069611" | "20040094432" | "20040112763" | "20040166019" | "20040168933" | "20040226123" | "20040250323" | "20040256247" | "20050103644" | "20050121334" | "20050126928" | "20050136520" | "20050139239" | "20050139465" | "20050139808" | "20050194261" | "20050244556" | "20060037869" | "20060054205" | "20060076248" | "20060162735" | "20060169575" | "20060231503" | "20060263240" | "20060272120" | "20060280664" | "20070009376" | "20070023273" | "20070037267" | "20070141434" | "20070170072" | "20070186367" | "20070186368" | "20070186369" | "20070186954" | "20070186957" | "20070186958" | "20070187261" | "20070187262" | "20070187263" | "20070272549" | "20080264778" | "20080272060" | "20090008268" | "20090127128" | "20090148342" | "20090162505" | "20090184186" | "20090212132" | "20090235481" | "20100147700" | "20100181208" | "20100189805" | "20100192987" | "20100276301" | "20110121110" | "2288956" | "3725226" | "3859195" | "3897320" | "3933614" | "4018658" | "4099489" | "4105528" | "4108052" | "4121543" | "4129493" | "4154578" | "4244079" | "4324635" | "4374711" | "4405418" | "4502929" | "4574037" | "4600495" | "4630167" | "4663091").PN. OR ("4670113" | "4676882" | "4705191" | "4734176" | "4810344" | "4832230" | "4875988" | "4956071" | "5101110" | "5186860" | "5234563" | "5250161" | "5292406" | "5316646" | "5320718" | "5378339" | "5536389" | "5590439" | "5593476" | "5632870" | "5661237" | "5665212" | "5733434" | "5762779" | "5766438" | "5779891" | "5815869" | "5824200" | "5835680" | "5853562" | "5858201" | "5858202" | "5928505" | "5930105" | "5931859" | "5997717" | "6016973" | "6032655" | "6059941" | "6088211" | "6101671" | "6110353" | "6132572" | "6200434" | "6231747" | "6315886" | "6336430" | "6375827" | "6379628" | "6409895" | "6425958" | "6488016" | "6502766" | "6585827" | "6638364" | "6652719" | "6656334" | "6689262" | "6703785" | "6719891" | "6735812" | "6842940" | "6855233" | "6878287" | "6921743" | "6926819" | "6964739" | "6974561" | "6991593" | "7008523" | "7011739" | "7059013" | "7107046" | "7156962" | "7160472" | "7226542" | "7238272" | "7303300" | "7309136" | "7836543" | "7891046" | "8007654" | "8012339" | "8012340" | "8025786" | "8025787" | "8046867" | "8062499").PN. OR ("8337690").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:14
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EAST Search History

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S39	160	("20010002500" | "20010112314" | "20020023847" | "20020027070" | "20020032141" | "20020074237" | "20020112314" | "20020185423" | "20030001439" | "20030062068" | "20030070919" | "20030102270" | "20030159230" | "20030159231" | "20030159233" | "20030164306" | "20030213505" | "20040011665" | "20040012913" | "20040037737" | "20040069611" | "20040094432" | "20040112763" | "20040166019" | "20040168933" | "20040226123" | "20040250323" | "20040256247" | "20050103644" | "20050121334" | "20050126928" | "20050136520" | "20050139239" | "20050139808" | "20050194261" | "20050244556" | "20060037869" | "20060076248" | "20060162735" | "20060169575" | "20060231503" | "20060263240" | "20060280664" | "20070023273" | "20070037267" | "20070141434" | "20070170072" | "20070186367" | "20070186368" | "20070186369" | "20070186954" | "20070186957" | "20070186958" | "20070187261" | "20070187262" | "20070187263" | "20070272549" | "20080264778" | "20090008268" | "20090127128" | "20090148342" | "20090162505" | "20090184186" | "20090212132" | "20090235481" | "20100189805" | "20100192987" | "3859195" | "3897320" | "3933614" | "4018658" | "4099489" | "4105528" | "4108052" | "4121543" | "4129493" | "4154578" | "4244079" | "4324635" | "4374711" | "4405418" | "4502929" | "4574037" | "4603167" | "4630167" | "4663091" | "4670113" | "4676882" | "4687558" | "4705191" | "4734176" | "4810344" | "4832230" | "4875988" | "4956071" | "5186860" | "5250161" | "5292406" | "5316646" | "5320718" | "5378339" | "5536389").PN. OR ("5590439" | "5632870" | "5665212" | "5733434" | "5762779" | "5766438" | "5779891" | "5815869" | "5824200" | "5853562" | "5858201" | "5858202" | "5928505" | "5931859" | "5997717" | "6016973" | "6032655" | "6059941" | "6088211" | "6101671" | "6110353" | "6132572" | "6200434" | "6231747" | "6315886" | "6375827" | "6379628" | "6409895" | "6425958" | "6488016" | "6502766" | "6585827" | "6638364" | "6652719" | "6689262" | "6703785" | "6719891" | "6735812" | "6842940" | "6855233" | "6878287" | "6921743" | "6926819" | "6964739" | "6974561" | "7008523" | "7011739" | "7059013" | "7156962" | "7160472" | "7226542" | "7238272" | "7836543" | "7891046" | "8007654" | "8012339" | "8012340" | "8025786" | "8025787").PN. OR ("8236147").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:14
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S41	0	13/247241	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:25
S42	0	"13247241"	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:25
S43	5	"7670495"	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:25
S44	29011	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 11:59
S45	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 11:59
S46	0	("2007/0284245").URPN.	USPAT	ADJ	ON	2013/01/17 12:08
S47	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same	US-PGPUB;	ADJ	ON	2013/01/17

EAST Search History

		(((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S44	USPAT; USOCR; FPRS; EPO; JPO; DERWENT			12:08
S48	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:09
S49	1178	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:09
S50	751	(pyramid$2 or triang$5 or funnel or conical or cone) with(anode or cathode or electrode) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:10
S51	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:11
S52	101	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (oxygen) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:11
S53	0	(platnium same (iridium with oxide)) same(anode or cathode or electrode) same (oxygen) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
S54	0	(platnium same (iridium with oxide)) same(anode or cathode or electrode) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
S55	38	(platinum same (iridium with oxide)) same(anode or cathode or electrode) same (oxygen) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
S56	34	"4,220,529"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/08/13 14:02
S57	8	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/08/27 08:39
S58	11	("5049252").URPN.	USPAT	ADJ	ON	2013/08/27 08:50
S59	1	"20080149485"	USPAT	ADJ	ON	2013/08/27 10:37
S60	3	"20080149485"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2013/08/27 10:37
S61	135	"4761208"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2013/08/27 11:18

EAST Search History

S62	14	"5,049,252"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/08/28 08:34
S63	243	(microbubble or nanobubble) and (saturat$3 or supersaturate$3) and "210"/$5.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/09/09 11:20
S64	38	(microbubble or nanobubble) and (saturat$3 or supersaturate$3) and (bod or biological adj oxygen adj demand) and "210"/$5.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/09/09 11:21
S65	8	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/09/09 12:41
S66	22	(microbubble or nanobubble) and (anode or cathode or electrode) and (bod or biological adj oxygen adj demand) and "210"/$5.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/09/09 13:37
S67	8	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/12/11 11:27
S68	14	"5049252"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/12/11 11:48
S69	2	("2007/0284245").URPN.	USPAT	ADJ	ON	2014/01/23 14:24
S70	19	("2003/0164306").URPN.	USPAT	ADJ	ON	2014/01/23 14:45
S71	7242	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:33
S72	2009	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap) and ("204"/$ or "205"/$).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:34
S73	963	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap) and ("205"/$).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:38
S74	1675	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap) and ("204"/$).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:40
S75	33201	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:41
S76	474	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap) and S75	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:41
S77	115	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or	US-PGPUB;	ADJ	ON	2014/01/23

EAST Search History

		distance or gap) same (oxygen or O2) and S75	USPAT; USOCR; FPRS; EPO; JPO; DERWENT			15:43
S78	8	(microbubble or nanobubble) same (anode or cathode or electrode) same (space$3 or distance or gap) same (oxygen or O2) and S75	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:44
S79	33201	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/24 07:13
S80	474	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap) and S79	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/24 07:13
S81	10	(microbubble or nanobubble) and (anode or cathode or electrode) and (bod or biological adj oxygen adj demand) and S79	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/24 07:14
S82	7	(microbubble or nanobubble) same (anode or cathode or electrode) same (space$3 or distance or gap) same (mm or "in." or inch) same (oxygen or O2) and S79	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/24 08:10
S83	44	(electrolytic electrochemical electrolytically electrochemically) near3 (oxygenat$6) and (oxygen) near3 (microbubble microbubbles nanobubble nanobubbles bubble bubbles)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/04 13:11
S84	188	(electrolytic electrochemical electrolytically electrochemically) same(oxygenat$6) and (oxygen) same (microbubble microbubbles nanobubble nanobubbles bubble bubbles)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/05 07:45
S85	92	(electrolytic electrochemical electrolytically electrochemically) same(oxygenat$6) and (oxygen) same (microbubble microbubbles nanobubble nanobubbles bubble bubbles) and (gap or space) same (electrode or anode or cathode)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/05 07:46
S86	21084	(bait or bucket or well or aquarium) same (electrode or anoe or cathode) same (oxygen$5)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/05 10:21
S87	8834	(bait or bucket or well or aquarium) with (electrode or anoe or cathode) same (oxygen$5)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/05 10:21
S88	3538	(bait or bucket or well or aquarium) with (electrode or anoe or cathode) with (oxygen$5)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/05 10:21
S89	16	(bait or bucket or aquarium) with (electrode or anoe or cathode) with (oxygen$5)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/05 10:21
S90	24	"6,419,815"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/05 10:39

EAST Search History

S91	0	"13247241"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/06 07:48
S92	8	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/06 07:48
S93	6	"20030091469"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/06 09:50
S94	80	(electrolytic electrochemical electrolytically electrochemically) same(oxygenat$6) and (oxygen) same (microbubble microbubbles nanobubble nanobubbles bubble bubbles) and (gap or space) same (electrode or anode or cathode) and oxide	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/06 10:11
S95	17	(electrolytic electrochemical electrolytically electrochemically) same(oxygenat$6) and (oxygen) same (microbubble microbubbles nanobubble nanobubbles bubble bubbles) and (gap or space) same (electrode or anode or cathode) same oxide	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/06 10:27
S96	1675	(205/628,633,742,756,757).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/06 10:46

2/7/2014 7:22:07 AM
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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13247241	SENKIW, JAMES ANDREW
	Examiner	Art Unit
	CAMERON J ALLEN	1774

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
210	739,746,748.01,748.16,748.15,748.17,748.19,749,757	1/16/2013	CA
422	22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308	1/16/2013	CA
204	155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2	1/16/2013	CA
205	701	1/16/2013	CA
22	192,321.7,1	1/17/2013	CA
205	628,633,742,756,757	2/06/2014	CA
119	263	2/07/2014	CA
210	167.21	2/27/2014	CA

SEARCH NOTES		
Search Notes	Date	Examiner
Google Search	1/16/2013	CA
See East Search History	1/16/2013	CA
Primary Joseph Drodge (General Assistance)	1/16/2013	CA
Inventor Search	1/16/2013	CA
See Updated East Search History	8/28/2013	CA
See Updated East Search History	2/06/2014	CA

INTERFERENCE SEARCH

US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
	See East Search	1/16/2013	CA
	See Updated East Search History	8/28/2013	CA

S/N 13/247,241 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Examiner: Cameron Allen

Serial No.:	13/247,241	Group Art Unit: 1774	
Filed:	September 28, 2011	Docket No.: 3406.005USR	
Customer No.:	21186	Confirmation No.: 1737	
Title:	Re-issue of U.S. Patent No. 7,670,495		

AMENDMENT & RESPONSE UNDER 37 C.F.R. 1.111

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant submits this Amendment and Response in reply to the Office Action dated March 25, 2014.

Applicant respectfully requests consideration of his amended claims presented herein.

IN THE CLAIMS

Please cancel claims 2-12, 13-49, 50-54, 60 – 65, 67, 68, 69, 71, 72, 73, 75, 76, 77, 78, 79, 82, 83, 84, 86.

Please amend claims 1, 55-59, 66, 70, 74, 80, 81 and 85 as follows.

1. (Allowed) A method for treating waste water comprising:
providing a flow-through oxygenator comprising an emitter for electrolytic generation of microbubbles of oxygen comprising an anode separated at a critical distance from a cathode and a power source all in electrical communication with each other,
placing the emitter within a conduit; and
passing waste water through the conduit.

Claims 2-12. (Cancelled).

Claims 13 – 49. (Cancelled).

Claims 50 - 54. (Cancelled).

55. (Once Amended) A method for producing an oxygenated aqueous composition comprising:

flowing water at a maximum flow rate of 12 gallons per minute through an electrolysis emitter comprising an electrical power source electrically connected to an anode electrode and a cathode electrode contained in a tubular housing,

causing electricity to flow from the power source to the electrodes, and,

producing the composition comprising a suspension comprising oxygen microbubbles and nanobubbles in the water, the microbubbles and nanobubbles having a bubble diameter of less than 50 microns and the microbubbles and nanobubbles being incapable of breaking the surface tension of the water, wherein:

the anode electrode is separated at a critical distance from the cathode such that the critical distance is from 0.005 inches to 0.140 inches;

the power source is produces a voltage maximum of about 28.3 volts and a maximum amperage of about 13 amps,

the tubular housing has an inlet and an outlet and a tubular flow axis from the inlet to the outlet;

the water flows in the inlet, out the outlet, is in fluid connection with the electrodes, has a conductivity produced by the presence of dissolved solids such that the water supports plant or animal life.

56. (Once Amended) A method according to claim 55 wherein the housing contains at least one anode and at least one cathode, the electrodes, are of a grid or solid design and are relatively positioned in cross section along the radius of the tubular housing with their long axes substantially parallel to the tubular water flow axis of the housing.

57. (Previously Presented) A method according to claim 55 wherein the housing has a side arm positioned at an angle relative to the tubular flow axis and the electrodes are located in the side arm.

58. (Previously Presented) A method according to claim 57 wherein the side arm contains a multiple number of anode and cathode electrodes and the electrodes are plate shaped.

59. (Twice Amended) A method according to claim 56 wherein [the] a multiple number of anode and cathodes are present and are of grid or solid design.

Claims 60 – 65 (Cancelled).

66. (Previously Presented) A method according to claim 55 wherein the water has a temperature no greater than about ambient temperature at the inlet and the water temperature is a factor for formation of the suspension.

Claims 67, 68, 69 (Cancelled).

70. (Previously Presented) A method according to claim 55 wherein the microbubbles and nanobubbles remain in the water at least in part for a period up to several hours.

Claims 71, 72, 73 (Cancelled).

74. (Previously Presented) A method according to claim 70 wherein the period for which the microbubbles and nanobubbles at least in part remain in the water is determined by containing the water with microbubbles and nanobubbles in a two and one half gallon aquarium reservoir container.

Claims 75, 76, 77, 78, 79 (Cancelled).

80. (Previously Presented) A method according to claim 55 wherein the microbubbles and nanobubbles supersaturate the water.

81. (Previously Presented) A method according to claim 55 wherein the bubble diameter of the microbubbles and nanobubbles is less than 0.0006 inches.

Claims 82, 83, 84 (Cancelled)

85. (Previously Presented) A method according to claim 55 wherein the separation of electrodes is maintained by a nonconductive spacer.

Claim 86 (Cancelled).

REMARKS

This Amendment is submitted in response to the Office Action dated March 25, 2014. Claims 1, 55-59, 66, 70, 74, 80, 81 and 85 are pending. All other claims have been cancelled.

The PTO has stated that the claims presented above would be allowable if all formal requirements are complied with. Applicant submits that the foregoing claims comply with this requirement pursuant to 37 CFR 1.173. Applicant has indicated the number of times each claim has been amended relative to its original presentation. Applicant has bracketed subject matter that is to be deleted from the pending claims (see claim 59) and has underlined new amended subject matter, if any (none).

Applicant reserves the right to submit a continuation reissue application to address the PTO concerns in regard to the system and suspension claims cancelled by this amendment.

Text of Claim 1

The undersigned attorney states that claim 1 as presented in the foregoing claims repeats the correct text of claim 1 allowed in the PTO action of March 6, 2013. This action addressed the preliminary amendment of September 28, 2013 in which amended claims and new claims were presented. Because original claim 1 was not amended, the text of original claim 1 was not recited in this preliminary amendment. In the subsequent amendment of July 8, 2013, the text of claim 1 was included. However, the text of claim 1 from sister patent, U.S. 7,396,441 was inadvertently and incorrectly copied as the text of claim 1 for this reissue application instead of the text of original allowed claim 1. This mistake is corrected in this amendment. The text of original claim 1 of U.S. 7,670,495 is now presented as an allowed claim of this reissue application.

The undersigned attorney called Examiner Allen on May 12, 2014 to inform Examiner Allen of the mistake and the correction. The undersigned attorney apologizes for the mistake and states that the text of claim 1 allowed by Examiner Allen is now presented in this amendment.

Applicant and Assignee submit that this reissue application is now in condition for allowance. A favorable action upon reconsideration is respectfully requested.

CONCLUSION

Applicant respectfully submits that the pending claims as presented are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's representative at (612) 373-6939 to facilitate prosecution of this application.

If necessary, please charge any additional fees or deficiencies, or credit any overpayments to Deposit Account No. 19-0743.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402--0938
(612) 373-6939

Date May 13, 2014

By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

Electronic Acknowledgement Receipt	
EFS ID:	19015354
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Thomas F. Brennan/Tara McMillen
Filer Authorized By:	Thomas F. Brennan
Attorney Docket Number:	3406.005USR
Receipt Date:	13-MAY-2014
Filing Date:	28-SEP-2011
Time Stamp:	12:12:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406005USR-AARN.pdf	174933 9d35830a65b1d865a3ffb394ded8b62f8a79f486	yes	7

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Amendment/Req. Reconsideration-After Non-Final Reject	2	2
	Claims	3	5
	Applicant Arguments/Remarks Made in an Amendment	6	7
Warnings:			
Information:			
	Total Files Size (in bytes):	174933	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Title: Re-issue of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	June 25, 2014
Examiner:	Cameron Allen	Group Art Unit:	1774
Customer No.:	21186	Confirmation No.:	1737

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Amendment and Response under 37 C.F.R. § 1.111 (6 pgs.)

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By: /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/247,241	Filing Date 09/28/2011	☐ To be Mailed

ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	05/13/2014	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 12	Minus	** 87	= 0	X $40 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	***5	= 0	X $210 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/PEARLIE A. FENNELL/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Modified form PTO/SB/08A(04-07) OMB 651-0031
US Patent & Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	13/247,241
	Filing Date	September 28, 2011
	First Named Inventor	
	Group Art Unit	1774
	Examiner Name	Cameron Allen
Sheet 1 of 1	Attorney Docket No: 3406.005USR	

US PATENT DOCUMENTS

Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document
	US-4,179,347	12/18/1979	Krause, William A., et al.
	US-5,728,287	3/17/1998	Hough, Gary S, et al.
	US-6,110,353	8/29/2000	Hough, Gary S
	US-6,478,949	11/12/2002	Hough, Gary S, et al.

FOREIGN PATENT DOCUMENTS

Examiner Initial *	Foreign Document Number	Publication Date	Name of Patentee or Applicant of cited Document	T 1

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS

Examiner Initial *	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T 1

EXAMINER DATE CONSIDERED

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant is to place a check mark here if English language Translation is attached

Electronic Patent Application Fee Transmittal	
Application Number:	13247241
Filing Date:	28-Sep-2011
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Filer:	Garrett M. Hall/Tikvah Kolbow
Attorney Docket Number:	3406.005USR
Filed as Small Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Submission- Information Disclosure Stmt	2806	1	90	90
		Total in USD ($)		**90**

Electronic Acknowledgement Receipt	
EFS ID:	19541653
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Garrett M. Hall/Tikvah Kolbow
Filer Authorized By:	Garrett M. Hall
Attorney Docket Number:	3406.005USR
Receipt Date:	10-JUL-2014
Filing Date:	28-SEP-2011
Time Stamp:	12:54:27
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$90
RAM confirmation Number	8770
Deposit Account	190743
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		13247241_SIDS_07-10-14.pdf	233683 aaef0915cd7462370563cbcbaf78735d91f8fc5b	yes	4

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Transmittal Letter	2	3
	Information Disclosure Statement (IDS) Form (SB08)	4	4

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30591 dda90b6c160945cb2a0a7eb5c8e97d59db606fff	no	2

Warnings:

Information:

Total Files Size (in bytes):	264274

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):
Title: Re-issue of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	N/A
Examiner:	Cameron Allen	Group Art Unit:	1774
Customer No.:	21186	Confirmation No.:	1737

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Supplemental Information Disclosure Statement (2 pgs.), Form 1449 (1 pg.) Documents NOT enclosed, citing US patents
X Authorization to charge Deposit Account 19-0743 in the amount of $90.00 to cover the fee for consideration of Information Disclosure Statement under 37 C.F.R. § 1.97(c).

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By: /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

S/N 13/247,241 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):		Examiner: Cameron Allen	
Serial No.:	13/247,241	Group Art Unit: 1774	
Filed:	September 28, 2011	Docket: 3406.005USR	
Customer No.:	21186	Confirmation No.: 1737	
Title:	Re-issue of U.S. Patent No. 7,670,495		

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In compliance with the duty imposed by 37 C.F.R. § 1.56, and in accordance with 37 C.F.R. §§ 1.97 *et. seq*., the enclosed materials are brought to the attention of the Examiner for consideration in connection with the above-identified patent application. Applicant respectfully requests that this Information Disclosure Statement be entered and the documents listed on the attached PTO 1449 Form be considered by the Examiner and made of record. Pursuant to the provisions of MPEP 609, Applicant requests that a copy of the PTO 1449 Form, initialed as being considered by the Examiner, be returned to the Applicant with the next official communication.

Pursuant to 37 C.F.R. § 1.97(c)(2), Applicant hereby authorizes the Commissioner to charge the fee of $90.00 as set forth in 37 C.F.R. § 1.17(p), to Deposit Account No. 19-0743. Please charge any additional fees or deficiencies, or credit any overpayment to Deposit Account No. 19-0743.

Pursuant to 37 C.F.R. § 1.98(a)(2), copies of cited U.S. Patents and Published Applications, and Non-Published Applications identifiable by USPTO Serial Number, are no longer required to be provided to the Office. Applicant acknowledges the requirement to submit copies of foreign patent documents and non-patent literature in accordance with 37 C.F.R § 1.98(a)(2).

The Examiner is invited to contact the undersigned at the telephone number indicated if there are any questions regarding this communication.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 373-6939

Date July 10, 2014 By /Albin J. Nelson/

Albin J. Nelson
Reg. No. 28,650

AJN:tjk

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 13/247,241	Group Art Unit: 1774
Filed: September 28, 2011	Docket No.: 3406.005USR
Customer No.: 21186	Confirmation No.: 1737
Examiner: Cameron Allen	Re-issue of U.S. Patent No. 7,670,495

SUPPLEMENTAL AMENDMENT & RESPONSE

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant submits this Supplemental Amendment in connection with its earlier Amendment and Response filed May 13, 2014.

IN THE CLAIMS

Please amend claims 55 and 56 as follows. Please add new dependent claims 87 and 88.

1. (Allowed) A method for treating waste water comprising:
providing a flow-through oxygenator comprising an emitter for electrolytic generation of microbubbles of oxygen comprising an anode separated at a critical distance from a cathode and a power source all in electrical communication with each other,
placing the emitter within a conduit; and
passing waste water through the conduit.

Claims 2-54, 60-65, 67-69, 71-73, 75-79, 82-84, 86. (Cancelled).

55. (Currently Amended) A method for producing an oxygenated aqueous composition comprising:

flowing water at up to a maximum flow rate of 12 gallons per minute through an electrolysis emitter comprising an electrical power source electrically connected to an anode electrode and a cathode electrode contained in a tubular housing,

causing electricity to flow from the power source to the electrodes, and,

producing the composition comprising a suspension comprising oxygen microbubbles and nanobubbles in the water, the microbubbles and nanobubbles having a bubble diameter of less than 50 microns ~~and the microbubbles and nanobubbles being incapable of breaking the surface tension of the water~~, wherein:

the anode electrode is separated at a critical distance from the cathode such that the critical distance is from 0.005 inches to 0.140 inches;

the power source is produces a voltage up to a maximum of about 28.3 volts and an amperage up to a maximum amperage of about 13 amps,

the tubular housing has an inlet and an outlet and a tubular flow axis from the inlet to the outlet;

the water flows in the inlet, out the outlet, is in fluid connection with the electrodes, and has a conductivity produced by the presence of dissolved solids such that the water supports plant or animal life.

56. (Currently Amended) A method according to claim 55 wherein the housing contains at least one anode and at least one cathode, the electrodes, are of a grid or solid design and are relatively positioned in cross section along the radius of the tubular housing with their long axes substantially parallel to the tubular water flow axis of the housing.

57. (Previously Presented) A method according to claim 55 wherein the housing has a side arm positioned at an angle relative to the tubular flow axis and the electrodes are located in the side arm.

58. (Previously Presented) A method according to claim 57 wherein the side arm contains a multiple number of anode and cathode electrodes and the electrodes are plate shaped.

59. (Previously Presented) A method according to claim 56 wherein a multiple number of anode and cathodes are present and are of grid or solid design.

66. (Previously Presented) A method according to claim 55 wherein the water has a temperature no greater than about ambient temperature at the inlet and the water temperature is a factor for formation of the suspension.

70. (Previously Presented) A method according to claim 55 wherein the microbubbles and nanobubbles remain in the water at least in part for a period up to several hours.

74. (Previously Presented) A method according to claim 70 wherein the period for which the microbubbles and nanobubbles at least in part remain in the water is determined by containing

the water with microbubbles and nanobubbles in a two and one half gallon aquarium reservoir container.

80. (Previously Presented) A method according to claim 55 wherein the microbubbles and nanobubbles supersaturate the water.

81. (Previously Presented) A method according to claim 55 wherein the bubble diameter of the microbubbles and nanobubbles is less than 0.0006 inches.

85. (Previously Presented) A method according to claim 55 wherein the separation of electrodes is maintained by a nonconductive spacer.

87. (New) A method according to claim 55 wherein the electrode separation distance is about 0.045 to about 0.06 inches.

88. (New) A method according to claim 55 wherein the microbubbles and nanobubbles are substantially incapable of breaking the surface tension of the water.

REMARKS

This Supplemental Amendment is submitted in furtherance of the Amendment filed May 13, 2014 in response to the Office Action dated March 25, 2014. Claims 1, 55-59, 66, 70, 74, 80, 81 and 85 are pending. Claims 87 and 88 are new.

Applicant has made the amendments to claim 55 and 56 in order to clarify certain terms therein. The claim phrases of claim 55 concerning maxima are understood to include all values up to the maxima. Inclusion of the phrase "up to" makes explicit this understanding. The word "and" has been added to correct for proper English. The phrase of claim 55 concerning "surface tension" has been removed as it is substantially redundant with respect to the recited bubble size. See the specification at 4:27-41. Claim 56 has been amended to remove an extraneous comma.

Applicant adds claims 87 and 88 as claims dependent from independent claim 55. Claim 87 is supported by the specification at 3:13-14. Claim 88 recites the "surface tension" phrase taken from claim 55 and is supported by the specification at 4:27-41.

Applicant and Assignee submit that this reissue application is now in condition for allowance. A favorable action upon reconsideration is respectfully requested.

The Examiner is invited to telephone Applicant's representative at (612) 373-6939 to facilitate prosecution of this application.

If necessary, please charge any additional fees or deficiencies, or credit any overpayments to Deposit Account No. 19-0743.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402--0938
(612) 373-6939

Date July 18, 2014

By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

Electronic Acknowledgement Receipt	
EFS ID:	19620838
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Thomas F. Brennan/Tara McMillen
Filer Authorized By:	Thomas F. Brennan
Attorney Docket Number:	3406.005USR
Receipt Date:	18-JUL-2014
Filing Date:	28-SEP-2011
Time Stamp:	14:48:04
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406005USR-SupAmend-signed.pdf	169316 a55286719bfc8e880daeaf2b6a62c870266360d7	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Supplemental Response or Supplemental Amendment	2	2
	Claims	3	5
	Applicant Arguments/Remarks Made in an Amendment	6	6
Warnings:			
Information:			
	Total Files Size (in bytes):	169316	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Re-issue of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	N/A
Examiner:	Cameron Allen	Group Art Unit:	1774
Customer No.:	21186	Confirmation No.:	1737

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Supplemental Amendment and Response (5 pgs.)

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/247,241	Filing Date 09/28/2011	☐ To be Mailed

ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)		
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	07/18/2014	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 14	Minus	** 87	= 0	X $40 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	***5	= 0	X $210 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/MARQUITA JONES/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 13/247,241	Group Art Unit: 1774
Filed: September 28, 2011	Docket No.: 3406.005USR
Customer No.: 21186	Confirmation No.: 1737
Examiner: Cameron Allen	Re-issue of U.S. Patent No. 7,670,495

SECOND SUPPLEMENTAL AMENDMENT & RESPONSE

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant submits this Second Supplemental Amendment in furtherance of his earlier Amendments of May 13, 2014 and July 18, 2014.

IN THE CLAIMS

Please amend claim 55 as follows.

Please add new dependent claims 89 and 90.

1. (Allowed) A method for treating waste water comprising:

providing a flow-through oxygenator comprising an emitter for electrolytic generation of micro bubbles of oxygen comprising an anode separated at a critical distance from a cathode and a power source all in electrical communication with each other,

placing the emitter within a conduit; and

passing waste water through the conduit.

Claims 2-54 (Previously Cancelled).

55. (Currently Amended) A method for producing an oxygenated aqueous composition comprising:

flowing water at a flow rate no greater than [up to a maximum flow rate of] 12 gallons per minute through an electrolysis emitter comprising an electrical power source electrically connected to an anode electrode and a cathode electrode contained in a tubular housing,

causing electricity to flow from the power source to the electrodes, and,

producing the composition comprising a suspension comprising oxygen microbubbles and nanobubbles in the water, the microbubbles and nanobubbles having a bubble diameter of less than 50 microns, wherein:

the anode electrode is separated at a critical distance from the cathode such that the critical distance is from 0.005 inches to 0.140 inches;

the power source [is] produces a voltage no greater than [up to a maximum of] about 28.3 volts and an amperage no greater than [up to a maximum amperage of] about 13 amps,

the tubular housing has an inlet and an outlet and a tubular flow axis from the inlet to the outlet;

the water flows in the inlet, out the outlet, is in fluid connection with the electrodes, and the water flowing into the inlet has a conductivity produced by the presence of dissolved solids such that the water supports plant or animal life.

56. (Previously Presented) A method according to claim 55 wherein the housing contains at least one anode and at least one cathode, the electrodes are of a grid or solid design and are relatively positioned in cross section along the radius of the tubular housing with their long axes substantially parallel to the tubular water flow axis of the housing.

57. (Previously Presented) A method according to claim 55 wherein the housing has a side arm positioned at an angle relative to the tubular flow axis and the electrodes are located in the side arm.

58. (Previously Presented) A method according to claim 57 wherein the side arm contains a multiple number of anode and cathode electrodes and the electrodes are plate shaped.

59. (Previously Presented) A method according to claim 56 wherein a multiple number of anode and cathodes are present and are of grid or solid design.

Claims 60 - 65 (Previously Cancelled).

66. (Previously Presented) A method according to claim 55 wherein the water has a temperature no greater than about ambient temperature at the inlet and the water temperature is a factor for formation of the suspension.

Claims 67, 68, 69 (Previously Cancelled).

70. (Previously Presented) A method according to claim 55 wherein the microbubbles and nanobubbles remain in the water at least in part for a period up to several hours.

Claims 71, 72, 73 (Previously Cancelled).

74. (Previously Presented) A method according to claim 70 wherein the period for which the microbubbles and nanobubbles at least in part remain in the water is determined by containing the water with microbubbles and nanobubbles in a two and one half gallon aquarium reservoir container.

Claims 75, 76, 77, 78, 79 (Previously Cancelled).

80. (Previously Presented) A method according to claim 55 wherein the microbubbles and nanobubbles supersaturate the water.

81. (Previously Presented) A method according to claim 55 wherein the bubble diameter of the microbubbles and nanobubbles is less than 0.0006 inches.

Claims 82, 83, 84 (Previously Cancelled)

85. (Previously Presented) A method according to claim 55 wherein the separation of electrodes is maintained by a nonconductive spacer.

Claim 86 (Previously Cancelled).

87. (Previously Presented) A method according to claim 55 wherein the electrode separation distance is about 0.045 to about 0.06 inches.

88. (Previously Presented) A method according to claim 55 wherein the microbubbles and nanobubbles are substantially incapable of breaking the surface tension of the water.

89. (New) A method according to claim 55 wherein each anode and cathode electrode of the emitter is positioned so that substantially all points midway between opposing anode and cathode electrodes are closer to a surface of the tubular housing than to a center point within the tubular housing.

90. (New) A method according to claim 89 wherein each anode and cathode electrode of the emitter are positioned so that the electrodes do not obstruct a water flow passage along the center of the tubular housing.

REMARKS

This second supplemental amendment is presented in furtherance of the Amendments of May 13, 2014 and July 18, 2014. All three amendments are in response to the office action dated March 25, 2014.

Applicant has clarified the language of main claim 55 by correcting a typo (cancellation of "is") and further characterizing the recited range of flow rate, amperage and voltage. The limitations relating to maximums of flow rate, amperage, and voltage have been clarified using the words "no greater than" as a substitute for the previous language of "up to." A device used in the method need not be capable of operating at the maximum but rather may be operated at a value less than or equal to the recited values. The phrase "the water flowing into the inlet" has been added to indicate that the water flowing into the inlet meets the conductivity recitation.

Two new dependent claims (89, 90) depend from claim 55. These claims further distinguish the invention from arrangements in which electrodes are positioned at or near the center of a housing. Such center positioning can hinder a central water flow passage.

No new matter is added by the claims 89 and 90. Support for these claims can be found in FIG. 7A and at column 9:5-18. FIG. 7A, for example, shows the electrode positioning as recited by these claims.

Applicant and Assignee submit that this reissue application is now in condition for allowance. A favorable action upon reconsideration is respectfully requested.

The Examiner is invited to telephone Applicant's representative at (612) 373-6939 to facilitate prosecution of this application.

If necessary, please charge any additional fees or deficiencies, or credit any overpayments to Deposit Account No. 19-0743.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402--0938
(612) 373-6939

Date Sept. 17, 2014

By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

Electronic Acknowledgement Receipt	
EFS ID:	20162389
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Thomas F. Brennan/Tara McMillen
Filer Authorized By:	Thomas F. Brennan
Attorney Docket Number:	3406.005USR
Receipt Date:	17-SEP-2014
Filing Date:	28-SEP-2011
Time Stamp:	12:51:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406005USR-AMD-signed.pdf	178319 c06072798ab1b5c32544a7163d5d8683817bf148	yes	8

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Preliminary Amendment	2	2
	Claims	3	6
	Applicant Arguments/Remarks Made in an Amendment	7	8
Warnings:			
Information:			
	Total Files Size (in bytes):	178319	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
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National Stage of an International Application under 35 U.S.C. 371
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New International Application Filed with the USPTO as a Receiving Office
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Re-issue of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	N/A
Examiner:	Cameron Allen	Group Art Unit:	1774
Customer No.:	21186	Confirmation No.:	1737

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Second Supplemental Amendment and Response (7 pgs.)

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743. If applicable, any papers or fees supplied herewith are considered to be timely filed pursuant to 37 C.F.R. § 1.7(a), the response period falling on a Federal Holiday, Saturday or Sunday being extended to the next succeeding business day.

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By: /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/247,241	Filing Date 09/28/2011	☐ To be Mailed

ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	09/17/2014	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 16	Minus	** 87	= 0	X $40 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	***5	= 0	X $210 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/HALLEY MASSEY/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor: Jame Andrew Senkiw
Re-issue of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	N/A
Examiner:	Cameron Allen	Group Art Unit:	1774
Customer No.:	21186	Confirmation No.:	1737

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the attached:

X Communication Re: Submission of Reissue Declaration (1 pg.).
X Signed Reissue Declaration (3 pgs.).

It is believed that no additional fee is required. However, if necessary, please charge any additional required fees or credit overpayment to Deposit Account No. 19-0743.

Schwegman Lundberg & Woessner, P.A.
Customer No: 21186

By: /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

S/N 13/247,241 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor:	Jame Andrew Senkiw	Examiner: Cameron Allen
Serial No.:	13/247,241	Group Art Unit: 1774
Filed:	September 28, 2011	Docket: 3406.005USR
Customer No.: 21186		Confirmation No.: 1737
Title:	Re-issue of U.S. Patent No. 7,670,495	

COMMUNICATION RE: SUBMISSION OF REISSUE DECLARATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant hereby submits a copy of the signed Reissue Declaration of Inventorship.

Applicant assumes the application is now in proper order and in condition for allowance. Please direct any inquiries to the undersigned at (612) 373-6939. If necessary, please charge any additional fees or credit overpayment to Deposit Account 19-0743.

Respectfully submitted,

Schwegman Lundberg & Woessner, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 373-6939

Date October 13, 2014 By /Albin J. Nelson/

Albin J. Nelson
Reg. No. 28,650

SCHWEGMAN ■ LUNDBERG ■ WOESSNER

United States Patent Application

REISSUE DECLARATION OF INVENTORSHIP

As a below named inventor I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that

I believe I am the original, first and sole inventor of the subject matter which is described and claimed in U.S. Patent No. **7,670,495** which was issued on **March 2, 2010** and of the subject matter claimed in the broadening reissue patent application Serial No. 13/247,241 filed September 28, 2011 and as amended by the prior filed amendments and the substitute supplemental amendment filed herewith, which reissue patent application corresponds to U.S. Patent No. **7,670,495** the specification of which was submitted to the U.S. PTO September 28, 2011.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by the prior filed amendments and the substitute supplemental amendment filed herewith.

I acknowledge the duty to disclose information which is material to the patentability of this reissue application in accordance with 37 C.F.R. § 1.56 (attached hereto).

I state pursuant to 37 C.F.R §1.175(a) that I, the Applicant, believe the original patent to be partly inoperative or invalid by reason of the patentee claiming less than the patentee had a right to claim in the patent. I believe that the errors to be relied upon as the basis for reissue are to be found in the text of the claims of the patent in that they do not encompass the full scope of Applicant's invention and unnecessarily limit that scope.

I state that every error in the patent which was and is corrected in the present reissue application pursuant to amendments previously submitted and submitted herewith and which are not covered by a prior oath/declaration submitted for this application arose without any deceptive intention on my part as Applicant.

I understand that pursuant to 37 C.F.R. §3.71, the assignee, Oxygenator Water Technologies, Inc., has granted the power of attorney, for prosecuting this reissue patent application and for transacting all related business, to attorneys and agents of the firm of Schwegman, Lundberg, & Woessner, P. A., **Customer Number 21186**. I confirm and agree with this appointment.

Please direct all correspondence and all communications to **Schwegman, Lundberg & Woessner, P.A.,** at the address provided by the following customer number.

Customer Number: 21186

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of James Andrew Senkiw
Citizenship: U.S.A
Residence: Minneapolis, MN
Post Office Address: 4750 Aldrich Ave N, Minneapolis MN 55430-3529

Signature: _____ Date: 13 OCT 2014
James Andrew Senkiw

§ 1.56 Duty to disclose information material to patentability.

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application:

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

Electronic Acknowledgement Receipt	
EFS ID:	20399468
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Thomas F. Brennan/Tara McMillen
Filer Authorized By:	Thomas F. Brennan
Attorney Docket Number:	3406.005USR
Receipt Date:	13-OCT-2014
Filing Date:	28-SEP-2011
Time Stamp:	16:17:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406005USR-Declaration-signed.pdf	316027 ba806db2c9e01927b4a4c1b20bcb9661affc27b5	yes	5

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Miscellaneous Incoming Letter	2	2
	Oath or Declaration filed	3	5
Warnings:			
Information:			
	Total Files Size (in bytes):	316027	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 13/247,241	Group Art Unit: 1774
Filed: September 28, 2011	Docket No.: 3406.005USR
Customer No.: 21186	Confirmation No.: 1737
Re-issue of U.S. Patent No. 7,670,495	Examiner: Cameron Allen

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SECOND SUBSTITUTE SUPPLEMENTAL AMENDMENT & RESPONSE

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Pursuant to a discussion between the examiner and the undersigned attorney, applicant submits this Second Substitute Supplemental Amendment and Response as a replacement of the Substitute Supplemental Amendment submitted September 23, 2014.

This Second Substitute Supplemental Amendment presents claims not present in U.S Patent No. 7,670,495 as underlined new claims even through several of these claim were presented and amended in previous amendments and responses. The texts of the claims of this Second Substitute Supplemental Amendment are the same as the texts of the claims presented in the Substitute Supplemental Amendment of September 23rd. However, this Second Substitute Supplemental Amendment does NOT present these claims with bracketing of cancelled words and underlining of new words relative to those same claims previously presented. Instead, each claim is presented in "clean" form with completely underlined text as if it had not been previously presented.

This Second Substitute Supplemental Amendment and the Supplemental Reissue Declaration of Inventorship attached hereto are submitted pursuant to instruction from the U.S. PTO re-issue specialist and the examiner in charge. If further formalities need to be changed, please call the undersigned attorney. The undersigned attorney will rapidly provide such changes so that this re-issue application can be passed to issuance.

Applicant respectfully requests consideration of his amended claims presented herein.

IN THE CLAIMS

1. (Allowed) A method for treating waste water comprising:
providing a flow-through oxygenator comprising an emitter for electrolytic generation of microbubbles of oxygen comprising an anode separated at a critical distance from a cathode and a power source all in electrical communication with each other,
placing the emitter within a conduit; and
passing waste water through the conduit.

Claims 2-12 are cancelled.

13. (New) A method for producing an oxygenated aqueous composition comprising:

flowing water at a flow rate no greater than 12 gallons per minute through an electrolysis emitter comprising an electrical power source electrically connected to an anode electrode and a cathode electrode contained in a tubular housing,

causing electricity to flow from the power source to the electrodes, and,

producing the composition comprising a suspension comprising oxygen microbubbles and nanobubbles in the water, the microbubbles and nanobubbles having a bubble diameter of less than 50 microns, wherein:

the anode electrode is separated at a critical distance from the cathode such that the critical distance is from 0.005 inches to 0.140 inches;

the power source produces a voltage no greater than about 28.3 volts and an amperage no greater than about 13 amps,

the tubular housing has an inlet and an outlet and a tubular flow axis from the inlet to the outlet;

the water flows in the inlet, out the outlet, is in fluid connection with the electrodes, and the water flowing into the inlet has a conductivity produced by the presence of dissolved solids such that the water supports plant or animal life.

14. (New) A method according to claim 13 wherein the housing contains at least one anode and at least one cathode, the electrodes are of a grid or solid design and are relatively positioned in cross section along the radius of the tubular housing with their long axes substantially parallel to the tubular water flow axis of the housing.

15. (New) A method according to claim 13 wherein the housing has a side arm positioned at an angle relative to the tubular flow axis and the electrodes are located in the side arm.

16. (New) A method according to claim 15 wherein the side arm contains a multiple number of anode and cathode electrodes and the electrodes are plate shaped.

17. (New) A method according to claim 14 wherein a multiple number of anode and cathodes are present and are of grid or solid design.

18. (New) A method according to claim 13 wherein the water has a temperature no greater than about ambient temperature at the inlet and the water temperature is a factor for formation of the suspension.

19. (New) A method according to claim 13 wherein the microbubbles and nanobubbles remain in the water at least in part for a period up to several hours.

20. (New) A method according to claim 19 wherein the period for which the microbubbles and nanobubbles at least in part remain in the water is determined by containing the water with microbubbles and nanobubbles in a two and one half gallon aquarium reservoir container.

21. (New) A method according to claim 13 wherein the microbubbles and nanobubbles supersaturate the water.

22. (New) A method according to claim 13 wherein the bubble diameter of the microbubbles and nanobubbles is less than 0.0006 inches.

23. (New) A method according to claim 13 wherein the separation of electrodes is maintained by a nonconductive spacer.

24. (New) A method according to claim 13 wherein the electrode separation distance is about 0.045 to about 0.06 inches.

25. (New) A method according to claim 13 wherein the microbubbles and nanobubbles are substantially incapable of breaking the surface tension of the water.

26. (New) A method according to claim 13 wherein each anode and cathode electrode of the emitter is positioned so that substantially all points midway between opposing anode and cathode electrodes are closer to a surface of the tubular housing than to a center point within the tubular housing.

27. (New) A method according to claim 26 wherein each anode and cathode electrode of the emitter are positioned so that the electrodes do not obstruct a water flow passage along the center of the tubular housing.

REMARKS

This Second Substitute Amendment is submitted in place of the Substitute Supplemental Amendment of September 23, 2014. This Substitute Supplemental Amendment follows the formal instruction from the re-issue specialist and the examiner that all claims not present in the original patent are to be presented as underlined new claims irrespective of whether they had been presented in previous amendments during this reissue prosecution. These new claims are to be consecutively numbered and are to include only the text proposed. Bracketing and underlining of terms relative to the terms of similar claims presented in prior amendments are not to be made.

Applicant understands that amendments to original claims present in issued U.S. Patent No. 7,670,495 are to be made relative to the language presented in those issued claims irrespective of intervening amendments. Because of the claim cancellations, the only original claim remaining is claim 1. NO amendments have been made to the original language of issued claim 1 of the '495 patent.

Applicant resubmits his supplemental Declaration of October 13th in regard to claimed subject matter not covered by his original re-issue Declaration or his first supplemental Declaration. Applicant has reviewed and agrees with the language of the claims presented herein as this claim language is the same as the claim language of the Substitute Supplemental Amendment of September 23rd. While the Declaration of October 13th refers to the "substitute supplemental amendment submitted herewith", this amendment had already been submitted to the PTO on September 23rd. Applicant reviewed this Sept. 23rd amendment attendant to his signing of the October 13th Declaration. Because the proposed texts of the claims of the September 23rd amendment and this current amendment are the same, submission of this second substitute supplemental amendment simultaneously with the re-submission of the October 13th Declaration perfects the Declaration statement regarding the "substitute supplemental amendment filed herewith."

In regard to the text of claim 13 and new claims 24-27, Applicant states the following.

Applicant has adopted certain language of main claim 13 to further characterize the recited range of flow rate, amperage and voltage. The limitations relating to maximums of flow rate, amperage, and voltage have been clarified using the words "no greater than." A device

used in the method need not be capable of operating at the maximum but rather may be operated at a value less than or equal to the recited values. The phrase "the water flowing into the inlet" has been adopted to indicate that the water flowing into the inlet meets the conductivity recitation.

New claims 24, 25, 26 and 27 are added as claims dependent from independent claim 13. Claims 26 and 27 further distinguish the invention from arrangements in which electrodes are positioned at or near the center of the housing. Such center positioning can hinder a central water flow passage.

No new matter is added by claims 24-27. Claim 24 is supported by the specification at 3:13-14. Claim 25 recites the "surface tension" phrase relative to the text of claim 13 and is supported by the specification at 4:27-41. Support for claims 26 and 27 can be found in FIG. 7A and at column 9:5-18. FIG. 7A, for example, shows the electrode positioning as recited by these claims.

Applicant and Assignee submit that this reissue application is now in condition for allowance. A favorable action upon reconsideration is respectfully requested.

CONCLUSION

Applicant respectfully submits that the pending claims as presented are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's representative at (612) 373-6939 to facilitate prosecution of this application.

If necessary, please charge any additional fees or deficiencies, or credit any overpayments to Deposit Account No. 19-0743.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402--0938
(612) 373-6939

Date October 20, 2014

By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

REMARKS

This Second Substitute Amendment is submitted in place of the Substitute Supplemental Amendment of September 23, 2014. This Substitute Supplemental Amendment follows the formal instruction from the re-issue specialist and the examiner that all claims not present in the original patent are to be presented as underlined new claims irrespective of whether they had been presented in previous amendments during this reissue prosecution. These new claims are to be consecutively numbered and are to include only the text proposed. Bracketing and underlining of terms relative to the terms of similar claims presented in prior amendments are not to be made.

Applicant understands that amendments to original claims present in issued U.S. Patent No. 7,670,495 are to be made relative to the language presented in those issued claims irrespective of intervening amendments. Because of the claim cancellations, the only original claim remaining is claim 1. NO amendments have been made to the original language of issued claim 1 of the '495 patent.

Applicant resubmits his supplemental Declaration of October 13th in regard to claimed subject matter not covered by his original re-issue Declaration or his first supplemental Declaration. Applicant has reviewed and agrees with the language of the claims presented herein as this claim language is the same as the claim language of the Substitute Supplemental Amendment of September 23rd. While the Declaration of October 13th refers to the "substitute supplemental amendment submitted herewith", this amendment had already been submitted to the PTO on September 23rd. Applicant reviewed this Sept. 23rd amendment attendant to his signing of the October 13th Declaration. Because the proposed texts of the claims of the September 23rd amendment and this current amendment are the same, submission of this second substitute supplemental amendment simultaneously with the re-submission of the October 13th Declaration perfects the Declaration statement regarding the "substitute supplemental amendment filed herewith."

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New claims 24, 25, 26 and 27 are added as claims dependent from independent claim 13. Claims 26 and 27 further distinguish the invention from arrangements in which electrodes are positioned at or near the center of the housing. Such center positioning can hinder a central water flow passage.

No new matter is added by claims 24-27. Claim 24 is supported by the specification at 3:13-14. Claim 25 recites the "surface tension" phrase relative to the text of claim 13 and is supported by the specification at 4:27-41. Support for claims 26 and 27 can be found in FIG. 7A and at column 9:5-18. FIG. 7A, for example, shows the electrode positioning as recited by these claims.

Applicant and Assignee submit that this reissue application is now in condition for allowance. A favorable action upon reconsideration is respectfully requested.

CONCLUSION

Applicant respectfully submits that the pending claims as presented are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's representative at (612) 373-6939 to facilitate prosecution of this application.

If necessary, please charge any additional fees or deficiencies, or credit any overpayments to Deposit Account No. 19-0743.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402--0938
(612) 373-6939

Date October 20, 2014

By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

SCHWEGMAN ■ LUNDBERG ■ WOESSNER

United States Patent Application

REISSUE DECLARATION OF INVENTORSHIP

As a below named inventor I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that

I believe I am the original, first and sole inventor of the subject matter which is described and claimed in U.S. Patent No. **7,670,495** which was issued on **March 2, 2010** and of the subject matter claimed in the broadening reissue patent application Serial No. 13/247,241 filed September 28, 2011 and as amended by the prior filed amendments and the substitute supplemental amendment filed herewith, which reissue patent application corresponds to U.S. Patent No. **7,670,495** the specification of which was submitted to the U.S. PTO September 28, 2011.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by the prior filed amendments and the substitute supplemental amendment filed herewith.

I acknowledge the duty to disclose information which is material to the patentability of this reissue application in accordance with 37 C.F.R. § 1.56 (attached hereto).

I state pursuant to 37 C.F.R §1.175(a) that I, the Applicant, believe the original patent to be partly inoperative or invalid by reason of the patentee claiming less than the patentee had a right to claim in the patent. I believe that the errors to be relied upon as the basis for reissue are to be found in the text of the claims of the patent in that they do not encompass the full scope of Applicant's invention and unnecessarily limit that scope.

I state that every error in the patent which was and is corrected in the present reissue application pursuant to amendments previously submitted and submitted herewith and which are not covered by a prior oath/declaration submitted for this application arose without any deceptive intention on my part as Applicant.

I understand that pursuant to 37 C.F.R. §3.71, the assignee, Oxygenator Water Technologies, Inc., has granted the power of attorney, for prosecuting this reissue patent application and for transacting all related business, to attorneys and agents of the firm of Schwegman, Lundberg, & Woessner, P. A., **Customer Number 21186**. I confirm and agree with this appointment.

Please direct all correspondence and all communications to **Schwegman, Lundberg & Woessner, P.A.,** at the address provided by the following customer number.

Customer Number: 21186

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of James Andrew Senkiw
Citizenship: U.S.A
Residence: Minneapolis, MN
Post Office Address: 4750 Aldrich Ave N, Minneapolis MN 55430-3529

Signature: _____ Date: 13 OCT 2014
James Andrew Senkiw

§ 1.56 Duty to disclose information material to patentability.

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application:

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

Electronic Acknowledgement Receipt	
EFS ID:	20463835
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Thomas F. Brennan/Tara McMillen
Filer Authorized By:	Thomas F. Brennan
Attorney Docket Number:	3406.005USR
Receipt Date:	20-OCT-2014
Filing Date:	28-SEP-2011
Time Stamp:	16:29:23
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406005USR-amendment-signed.pdf	361340 37d1064d4314c22b03820ebc601a545b7aa9962c	yes	10

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Supplemental Response or Supplemental Amendment	2	2
	Claims	3	5
	Applicant Arguments/Remarks Made in an Amendment	6	7
	Oath or Declaration filed	8	10
Warnings:			
Information:			
	Total Files Size (in bytes):	361340	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

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National Stage of an International Application under 35 U.S.C. 371
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New International Application Filed with the USPTO as a Receiving Office
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Re-issue of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	N/A
Examiner:	Cameron Allen	Group Art Unit:	1774
Customer No.:	21186	Confirmation No.:	1737

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Second Substitute Supplemental Amendment and Response (6 pgs.)
X Reissue Declaration of Inventorship (3 pgs.)

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743. If applicable, any papers or fees supplied herewith are considered to be timely filed pursuant to 37 C.F.R. § 1.7(a), the response period falling on a Federal Holiday, Saturday or Sunday being extended to the next succeeding business day.

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By: /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/247,241	Filing Date 09/28/2011	☐ To be Mailed

ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	10/20/2014	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 16	Minus	** 87	= 0	X $40 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	***5	= 0	X $210 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/JOY J. DOBBS/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

21186 7590 11/18/2014
SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER	
ALLEN, CAMERON J	
ART UNIT	PAPER NUMBER
1774	

DATE MAILED: 11/18/2014

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/247,241	09/28/2011	James Andrew Senkiw	3406.005USR	1737

TITLE OF INVENTION: FLOW-THROUGH OXYGENATOR

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	02/18/2015

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

21186 7590 11/18/2014
SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/247,241	09/28/2011	James Andrew Senkiw	3406.005USR	1737

TITLE OF INVENTION: FLOW-THROUGH OXYGENATOR

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	02/18/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
ALLEN, CAMERON J	1774	210-748010

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
❑ Issue Fee
❑ Publication Fee (No small entity discount permitted)
❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
❑ A check is enclosed.
❑ Payment by credit card. Form PTO-2038 is attached.
❑ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
❑ Applicant certifying micro entity status. See 37 CFR 1.29
NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
❑ Applicant asserting small entity status. See 37 CFR 1.27
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
❑ Applicant changing to regular undiscounted fee status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____
Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/247,241	09/28/2011	James Andrew Senkiw	3406.005USR	1737

21186 7590 11/18/2014

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER	
ALLEN, CAMERON J	

ART UNIT	PAPER NUMBER
1774	

DATE MAILED: 11/18/2014

Determination of Patent Term Extension or Adjustment under 35 U.S.C. 154 (b)

A reissue patent is for "the unexpired part of the term of the original patent." See 35 U.S.C. 251. Accordingly, the above-identified reissue application is not eligible for Patent Term Extension or Adjustment under 35 U.S.C. 154(b).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 13/247,241	Applicant(s) SENKIW, JAMES ANDREW	
	Examiner /CAMERON J. ALLEN/	Art Unit 1774	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *communication received on 10/20/2014*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1 and 13-27*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   Certified copies:
   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 7/10/2014
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

DETAILED ACTION

The present application is being examined under the pre-AIA first to invent provisions.

Allowable Subject Matter

Claims 1 and 13-27 are allowed. The following is a statement of reasons for the indication of allowable subject matter: The prior art does not disclose nor fairly suggest the method for producing oxygenated aqueous composition comprising the combination of the critical distance between the cathode and anode of .0005-0.140, the voltage maximum of about 28.3 volts, and 13 or less amperage with a maximum of 12 gallons per minute such that it results in the formation of a suspension comprising oxygen microbubbles and nanobubbles in the water, the nanobubbles having a bubble diameter of less than 50 microns.

Also, with respect to claim 1, the prior art of record, such as Murrell U.S. Patent 5,049,252, does not express nor fairly disclose the method step of placing the emitting device in the fluid to be treated. It discloses flowing the fluid through the device using a pie system.

Support for the amendments may be found at Column 2 lines 64-65, Column 9 lines 35-45 with Table III and Column 4 lines 12-13 and 27-41 also Column 3 lines 13-14.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to /CAMERON J. ALLEN/ whose telephone number is (571)270-3164. The examiner can normally be reached on M-Th 9-7pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Walter Griffin can be reached on 571-272-1447. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JOSEPH DRODGE/
Primary Examiner, Art Unit 1778

/CAMERON J. ALLEN/
Examiner
Art Unit 1774

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13247241	SENKIW, JAMES ANDREW
	Examiner	**Art Unit**
	CAMERON J ALLEN	1774

CPC		
Symbol	**Type**	**Version**

CPC Combination Sets				
Symbol	**Type**	**Set**	**Ranking**	**Version**

/CAMERON J ALLEN/ Examiner.Art Unit 1774 (Assistant Examiner)	10/27/2014 (Date)	**Total Claims Allowed:** 16	
/WALTER D GRIFFIN/ Supervisory Patent Examiner.Art Unit 1774 (Primary Examiner)	10/28/2014 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office — Part of Paper No. 20140908

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13247241	SENKIW, JAMES ANDREW
	Examiner	**Art Unit**
	CAMERON J ALLEN	1774

US ORIGINAL CLASSIFICATION						INTERNATIONAL CLASSIFICATION										
CLASS	SUBCLASS					CLAIMED					NON-CLAIMED					
210	739					C	0	2	F	1 / 48 (2006.0)						
CROSS REFERENCE(S)						C	0	2	F	1 / 00 (2006.0)						
						C	0	2	F	1 / 02 (2006.0)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					C	0	2	F	1 / 04 (2006.0)						
204	157.15	245	232	628	600											
210	600	243	153													
422	22	186	186.04													

/CAMERON J ALLEN/ Examiner.Art Unit 1774	10/27/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	16	
/WALTER D GRIFFIN/ Supervisory Patent Examiner.Art Unit 1774	10/28/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No. 20140908

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13247241	SENKIW, JAMES ANDREW
	Examiner	**Art Unit**
	CAMERON J ALLEN	1774

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

/CAMERON J ALLEN/ Examiner.Art Unit 1774	10/27/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	16	
/WALTER D GRIFFIN/ Supervisory Patent Examiner.Art Unit 1774	10/28/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office Part of Paper No. 20140908

Modified form PTO/SB/08A(04-07) OMB 651-0031
US Patent & Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	13/247,241
	Filing Date	September 28, 2011
	First Named Inventor	
	Group Art Unit	1774
	Examiner Name	Cameron Allen
Sheet 1 of 1	Attorney Docket No: 3406.005USR	

US PATENT DOCUMENTS

Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document
	US-4,179,347	12/18/1979	Krause, William A., et al.
	US-5,728,287	3/17/1998	Hough, Gary S, et al.
	US-6,110,353	8/29/2000	Hough, Gary S
	US-6,478,949	11/12/2002	Hough, Gary S, et al.

FOREIGN PATENT DOCUMENTS

Examiner Initial *	Foreign Document Number	Publication Date	Name of Patentee or Applicant of cited Document	T 1

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS

Examiner Initial *	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T 1

EXAMINER	/Cameron Allen/	DATE CONSIDERED	09/08/2014

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant is to place a check mark here if English language Translation is attached

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.A./

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L6	3	"6478949"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2014/09/08 10:58
L7	0	"13247241"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2014/09/08 11:34
L8	8981	(C02F1/48 or C02F1/00 or C02F1/04).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2014/09/08 11:37
S1	1255	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 12:45
S2	28341	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 13:32
S3	83	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2012/12/10 13:33
S4	6	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 11:48
S5	28493	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 12:37
S6	48	(anode or cathode or electrode)same (inch or in or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 12:37
S7	6	"10372017"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 12:51
S8	15	("20020074237" | "4225401" | "4252856" | "4587001" | "5015354" | "5534143" | "5982609" | "6171469" | "6315886" | "6328875" | "6394429" | "6689262").PN. OR ("7396441").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/14 12:52
S9	12	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:02

EAST Search History

S10	110	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:04
S11	0	("2007/0284245").URPN.	USPAT	ADJ	ON	2013/01/14 13:06
S12	3	("2007/0187262").URPN.	USPAT	ADJ	ON	2013/01/14 13:07
S13	1628	(anode or cathode or electrode)same (inch or "in.") and S5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:12
S14	28994	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:12
S15	1690	(anode or cathode or electrode)same (inch or "in.") and S14	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:12
S16	20	(anode or cathode or electrode)same (inch or "in.") same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:13
S17	32	(anode or cathode or electrode)same (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:16
S18	35	(anode or cathode or electrode)same6 (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:23
S19	10	(anode or cathode or electrode)same6 (inch or "in." or mm or cm) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S14	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/14 13:23
S20	29002	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:17
S21	12	(anode or cathode or electrode)same6 (inch or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S20	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:17
S22	12	(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S20	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/15 15:19
S23	39	("3404088" | "3479281" | "3562137" | "3619391" | "3783114" | "3816274" | "3816275" | "3817865" | "3853736" | "3898150" | "3904521" | "3920530" | "3925203" | "3944478" | "3975269" | "4012319" | "4075076" | "4189381" | "4197180" | "4202767" | "4294697" | "4311595" | "4623436" | "Re26329").PN. OR ("5049252").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/15 15:43
S24	6	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/16 07:44
S25	3	"20070102371"	US-PGPUB; USPAT; USOCR;	ADJ	ON	2013/01/16 09:48

EAST Search History

			FPRS; EPO; JPO; DERWENT			
S26	29011	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:32
S27	3	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:32
S28	8	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:33
S29	105	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:40
S30	14	(inner or outer or inside or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S26	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:41
S31	83	(inner or outer or concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:44
S32	2	(concentric) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:44
S33	2	(concentric) same6(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:47
S34	2	(concentric) same6 (anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 08:47
S35	3	("2007/0187262").URPN.	USPAT	ADJ	ON	2013/01/17 11:13
S36	3	("2007/0187261").URPN.	USPAT	ADJ	ON	2013/01/17 11:14
S37	189	("20010002500" | "20010034922" | "20020023847" | "20020027070" | "20020032141" | "20020038768" | "20020074237" | "20020112314" | "20020185423" | "20030001439" | "20030062068" | "20030070919" | "20030102270" | "20030159230" | "20030159231" | "20030159233" | "20030164306" | "20030213505" | "20040011665" | "20040012913" | "20040037737" | "20040042201" | "20040069611" | "20040094432" | "20040112763" | "20040166019" | "20040168933" | "20040226123" | "20040250323" | "20040256247" | "20050103644" | "20050121334" | "20050126928" | "20050136520" | "20050139239" | "20050139465" | "20050139808" | "20050194261" | "20050244556" | "20060037869" | "20060054205" | "20060076248" | "20060162735" | "20060169575" | "20060231503" | "20060263240" | "20060272120" | "20060280664" | "20070009376" | "20070023273" | "20070037267" | "20070141434" | "20070170072" | "20070186367" | "20070186368" | "20070186369" | "20070186954" | "20070186957" | "20070186958" | "20070187261" | "20070187262" | "20070187263" | "20070272549" | "20080264778" | "20080272060" | "20090008268" | "20090127128" | "20090148342" | "20090162505" | "20090184186" | "20090212132" | "20090235481" | "20100147700" | "20100181208" | "20100189805" | "20100192987" | "20100276301" | "20110121110" | "2288956" | "3725226" | "3859195" | "3897320" | "3933614" | "4018658" | "4099489" | "4105528" | "4108052" | "4121543" | "4129493" | "4154578" | "4244079" | "4324635" | "4374711" | "4405418" | "4502929" | "4574037" | "4600495" | "4630167" | "4663091").PN. OR ("4670113" | "4676882" | "4705191" | "4734176" | "4810344" | "4832230" | "4875988" | "4956071" | "5101110" | "5186860" | "5234563" | "5250161" | "5292406" | "5316646" | "5320718" | "5378339" | "5536389" | "5590439" | "5593476" | "5632870" | "5661237" | "5665212" | "5733434" | "5762779" | "5766438" | "5779891" | "5815869" | "5824200" | "5835680" | "5853562" | "5858201" | "5858202" | "5928505" | "5930105" | "5931859" | "5997717" | "6016973" | "6032655" | "6059941" | "6088211" | "6101671" | "6110353" | "6132572" | "6200434" | "6231747" | "6315886" | "6336430" | "6375827" |	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:14

EAST Search History

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S38	189	("20010002500" | "20010034922" | "20020023847" | "20020027070" | "20020032141" | "20020038768" | "20020074237" | "20020112314" | "20020185423" | "20030001439" | "20030062068" | "20030070919" | "20030102270" | "20030159230" | "20030159231" | "20030159233" | "20030164306" | "20030213505" | "20040011665" | "20040012913" | "20040037737" | "20040042201" | "20040069611" | "20040094432" | "20040112763" | "20040166019" | "20040168933" | "20040226123" | "20040250323" | "20040256247" | "20050103644" | "20050121334" | "20050126928" | "20050136520" | "20050139239" | "20050139465" | "20050139808" | "20050194261" | "20050244556" | "20060037869" | "20060054205" | "20060076248" | "20060162735" | "20060169575" | "20060231503" | "20060263240" | "20060272120" | "20060280664" | "20070009376" | "20070023273" | "20070037267" | "20070141434" | "20070170072" | "20070186367" | "20070186368" | "20070186369" | "20070186954" | "20070186957" | "20070186958" | "20070187261" | "20070187262" | "20070187263" | "20070272549" | "20080264778" | "20080272060" | "20090008268" | "20090127128" | "20090148342" | "20090162505" | "20090184186" | "20090212132" | "20090235481" | "20100147700" | "20100181208" | "20100189805" | "20100192987" | "20100276301" | "20110121110" | "2288956" | "3725226" | "3859195" | "3897320" | "3933614" | "4018658" | "4099489" | "4105528" | "4108052" | "4121543" | "4129493" | "4154578" | "4244079" | "4324635" | "4374711" | "4405418" | "4502929" | "4574037" | "4600495" | "4630167" | "4663091").PN. OR ("4670113" | "4676882" | "4705191" | "4734176" | "4810344" | "4832230" | "4875988" | "4956071" | "5101110" | "5186860" | "5234563" | "5250161" | "5292406" | "5316646" | "5320718" | "5378339" | "5536389" | "5590439" | "5593476" | "5632870" | "5661237" | "5665212" | "5733434" | "5762779" | "5766438" | "5779891" | "5815869" | "5824200" | "5835680" | "5853562" | "5858201" | "5858202" | "5928505" | "5930105" | "5931859" | "5997717" | "6016973" | "6032655" | "6059941" | "6088211" | "6101671" | "6110353" | "6132572" | "6200434" | "6231747" | "6315886" | "6336430" | "6375827" | "6379628" | "6409895" | "6425958" | "6488016" | "6502766" | "6585827" | "6638364" | "6652719" | "6656334" | "6689262" | "6703785" | "6719891" | "6735812" | "6842940" | "6855233" | "6878287" | "6921743" | "6926819" | "6964739" | "6974561" | "6991593" | "7008523" | "7011739" | "7059013" | "7107046" | "7156962" | "7160472" | "7226542" | "7238272" | "7303300" | "7309136" | "7836543" | "7891046" | "8007654" | "8012339" | "8012340" | "8025786" | "8025787" | "8046867" | "8062499").PN. OR ("8337690").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:14
S39	160	("20010002500" | "20010112314" | "20020023847" | "20020027070" | "20020032141" | "20020074237" | "20020112314" | "20020185423" | "20030001439" | "20030062068" | "20030070919" | "20030102270" | "20030159230" | "20030159231" | "20030159233" | "20030164306" | "20030213505" | "20040011665" | "20040012913" | "20040037737" | "20040069611" | "20040094432" | "20040112763" | "20040166019" | "20040168933" | "20040226123" | "20040250323" | "20040256247" | "20050103644" | "20050121334" | "20050126928" | "20050136520" | "20050139239" | "20050139808" | "20050194261" | "20050244556" | "20060037869" | "20060076248" | "20060162735" | "20060169575" | "20060231503" | "20060263240" | "20060280664" | "20070023273" | "20070037267" | "20070141434" | "20070170072" | "20070186367" | "20070186368" | "20070186369" | "20070186954" | "20070186957" | "20070186958" | "20070187261" | "20070187262" | "20070187263" | "20070272549" | "20080264778" | "20090008268" | "20090127128" | "20090148342" | "20090162505" | "20090184186" | "20090212132" | "20090235481" | "20100189805" | "20100192987" | "3859195" | "3897320" | "3933614" | "4018658" | "4099489" | "4105528" | "4108052" | "4121543" | "4129493" | "4154578" | "4244079" | "4324635" | "4374711" | "4405418" | "4502929" | "4574037" | "4603167" | "4630167" | "4663091" | "4670113" | "4676882" | "4687558" | "4705191" | "4734176" | "4810344" | "4832230" | "4875988" | "4956071" | "5186860" | "5250161" | "5292406" | "5316646" | "5320718" | "5378339" | "5536389").PN. OR ("5590439" | "5632870" | "5665212" | "5733434" | "5762779" | "5766438" | "5779891" | "5815869" | "5824200" | "5853562" | "5858201" | "5858202" | "5928505" | "5931859" | "5997717" | "6016973" | "6032655" | "6059941" | "6088211" | "6101671" | "6110353" | "6132572" | "6200434" | "6231747" | "6315886" | "6375827" | "6379628" | "6409895" | "6425958" | "6488016" | "6502766" | "6585827" | "6638364" | "6652719" | "6689262" | "6703785" | "6719891" | "6735812" | "6842940" | "6855233" | "6878287" | "6921743" | "6926819" | "6964739" | "6974561" | "7008523" | "7011739" | "7059013" | "7156962" | "7160472" | "7226542" | "7238272" | "7303300" | "7309136" | "7836543" | "7891046" | "8007654" | "8012339" | "8012340" | "8025786" | "8025787").PN. OR ("8236147").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:14
S40	185	("20010002500" | "20010034922" | "20020023847" | "20020027070" | "20020032141" | "20020038768" | "20020074237" | "20020112314" | "20020185423" | "20030001439" | "20030062068" | "20030070919" | "20030102270" | "20030159230" | "20030159231" | "20030159233" | "20030164306" | "20030213505" | "20040011665" | "20040012913" | "20040037737" | "20040042201" | "20040069611" | "20040094432" | "20040112763" | "20040166019" | "20040168933" | "20040226123" | "20040250323" | "20040256247" | "20050067289" | "20050103644" | "20050121334" | "20050126928" | "20050136520" | "20050139239" | "20050139465" | "20050139808" | "20050194261" | "20050244556" | "20060037869" | "20060054205" | "20060076248" | "20060162735" | "20060169575" | "20060231503" | "20060263240" | "20060280664" | "20070009376" | "20070023273" | "20070037267" | "20070141434" | "20070170072" | "20070186367" | "20070186368" | "20070186369" | "20070186954" | "20070186957" | "20070186958" | "20070187261" | "20070187262" | "20070187263" | "20070272549" | "20080264778" | "20080272060" | "20090008268" | "20090127128" | "20090148342" | "20090162505" | "20090184186" | "20090212132" | "20090235481" | "20100189805" | "20100192987" | "2288956" | "3725226" | "3859195" | "3897320" | "3933614" | "4018658" | "4099489" | "4105528" | "4108052" | "4121543" | "4129493" | "4154578" | "4244079" | "4324635" | "4374711" | "4405418" | "4502929" | "4574037" | "4600495" | "4603167" | "4630167" | "4663091" | "4670113" | "4676882" | "4687558" | "4705191").PN. OR ("4734176" | "4810344" | "4832230" | "4875988" | "4956071" | "5186860" | "5234563" | "5250161" | "5292406" | "5316646" | "5320718" | "5378339" | "5536389" | "5590439" | "5593476" | "5632870" | "5661237" | "5665212" | "5733434" | "5762779" | "5766438" | "5779891" | "5815869" | "5824200" | "5835680" | "5853562" | "5858201" | "5858202" | "5928505" | "5931859" | "5997717" | "6016973" | "6032655" | "6059941" | "6088211" | "6101671" | "6110353" | "6132572" | "6200434" | "6231747" | "6315886" | "6336430" | "6375827" | "6379628" | "6409895" | "6425958" | "6488016" | "6502766" | "6585827" | "6638364" | "6652719" | "6656334" | "6689262" | "6703785" | "6719891" | "6735812" | "6842940" | "6855233" | "6878287" | "6921743" | "6926819" | "6964739" | "6974561" | "6991593" | "7008523" | "7011739" | "7059013" | "7107046" | "7156962" | "7160472" | "7226542" | "7238272" | "7303300" | "7309136" | "7836543" | "7891046" | "8007654" | "8012339" | "8012340" | "8025786" | "8025787" | "8046867" | "8062499").PN. OR ("8319654").URPN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:15

EAST Search History

S41	0	13/247241	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:25
S42	0	"13247241"	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:25
S43	5	"7670495"	US-PGPUB; USPAT; USOCR	ADJ	ON	2013/01/17 11:25
S44	29011	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 11:59
S45	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode)same6 (inch$2 or "in." or mm or cm or gap) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 11:59
S46	0	("2007/0284245").URPN.	USPAT	ADJ	ON	2013/01/17 12:08
S47	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) same oxygen and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:08
S48	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:09
S49	1178	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:09
S50	751	(pyramid$2 or triang$5 or funnel or conical or cone) with(anode or cathode or electrode) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:10
S51	1	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:11
S52	101	(pyramid$2 or triang$5 or funnel or conical or cone) same(anode or cathode or electrode) same (oxygen) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:11
S53	0	(platnium same (iridium with oxide)) same(anode or cathode or electrode) same (oxygen) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
S54	0	(platnium same (iridium with oxide)) same(anode or cathode or electrode) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
S55	38	(platinum same (iridium with oxide)) same(anode or cathode or electrode) same (oxygen) and S44	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/01/17 12:39
S56	34	"4,220,529"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/08/13 14:02

EAST Search History

S57	8	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/08/27 08:39
S58	11	("5049252").URPN.	USPAT	ADJ	ON	2013/08/27 08:50
S59	1	"20080149485"	USPAT	ADJ	ON	2013/08/27 10:37
S60	3	"20080149485"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2013/08/27 10:37
S61	135	"4761208"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2013/08/27 11:18
S62	14	"5,049,252"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/08/28 08:34
S63	243	(microbubble or nanobubble) and (saturat$3 or supersaturate$3) and "210"/$5.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/09/09 11:20
S64	38	(microbubble or nanobubble) and (saturat$3 or supersaturate$3) and (bod or biological adj oxygen adj demand) and "210"/$5.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/09/09 11:21
S65	8	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/09/09 12:41
S66	22	(microbubble or nanobubble) and (anode or cathode or electrode) and (bod or biological adj oxygen adj demand) and "210"/$5.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/09/09 13:37
S67	8	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/12/11 11:27
S68	14	"5049252"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2013/12/11 11:48
S69	2	("2007/0284245").URPN.	USPAT	ADJ	ON	2014/01/23 14:24
S70	19	("2003/0164306").URPN.	USPAT	ADJ	ON	2014/01/23 14:45
S71	7242	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:33
S72	2009	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap) and ("204"/$ or "205"/$).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:34
S73	963	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or	US-PGPUB;	ADJ	ON	2014/01/23

EAST Search History

		distance or gap) and ("205"/$).ccls.	USPAT; USOCR; FPRS; EPO; JPO; DERWENT			15:38
S74	1675	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap) and ("204"/$).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:40
S75	33201	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:41
S76	474	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap) and S75	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:41
S77	115	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap) same (oxygen or O2) and S75	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:43
S78	8	(microbubble or nanobubble) same (anode or cathode or electrode) same (space$3 or distance or gap) same (oxygen or O2) and S75	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/23 15:44
S79	33201	(210/739,746,748.01,748.16,748.15,748.17,748.19,749,757 or 422/22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308 or 204/155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2 or 205/701 or 22/192,321.7,1).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/24 07:13
S80	474	(microbubble or nanobubble or bubble) same (anode or cathode or electrode) same (space$3 or distance or gap) and S79	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/24 07:13
S81	10	(microbubble or nanobubble) and (anode or cathode or electrode) and (bod or biological adj oxygen adj demand) and S79	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/24 07:14
S82	7	(microbubble or nanobubble) same (anode or cathode or electrode) same (space$3 or distance or gap) same (mm or "in." or inch) same (oxygen or O2) and S79	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/01/24 08:10
S83	44	(electrolytic electrochemical electrolytically electrochemically) near3 (oxygenat$6) and (oxygen) near3 (microbubble microbubbles nanobubble nanobubbles bubble bubbles)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/04 13:11
S84	188	(electrolytic electrochemical electrolytically electrochemically) same(oxygenat$6) and (oxygen) same (microbubble microbubbles nanobubble nanobubbles bubble bubbles)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/05 07:45
S85	92	(electrolytic electrochemical electrolytically electrochemically) same(oxygenat$6) and (oxygen) same (microbubble microbubbles nanobubble nanobubbles bubble bubbles) and (gap or space) same (electrode or anode or cathode)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/05 07:46
S86	21084	(bait or bucket or well or aquarium) same (electrode or anoe or cathode) same (oxygen$5)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/05 10:21
S87	8834	(bait or bucket or well or aquarium) with (electrode or anoe or cathode) same (oxygen$5)	US-PGPUB;	ADJ	ON	2014/02/05

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT			10:21
S88	3538	(bait or bucket or well or aquarium) with (electrode or anoe or cathode) with (oxygen$5)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/05 10:21
S89	16	(bait or bucket or aquarium) with (electrode or anoe or cathode) with (oxygen$5)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/05 10:21
S90	24	"6,419,815"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/05 10:39
S91	0	"13247241"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/06 07:48
S92	8	"7670495"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/06 07:48
S93	6	"20030091469"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/06 09:50
S94	80	(electrolytic electrochemical electrolytically electrochemically) same(oxygenat$6) and (oxygen) same (microbubble microbubbles nanobubble nanobubbles bubble bubbles) and (gap or space) same (electrode or anode or cathode) and oxide	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/06 10:11
S95	17	(electrolytic electrochemical electrolytically electrochemically) same(oxygenat$6) and (oxygen) same (microbubble microbubbles nanobubble nanobubbles bubble bubbles) and (gap or space) same (electrode or anode or cathode) same oxide	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/06 10:27
S96	1675	(205/628,633,742,756,757).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/06 10:46
S97	406	(119/263 or 210/167.21).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/07 06:10
S98	1	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S97	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:10
S99	1	("20060054205").PN.	US-PGPUB; USPAT; USOCR	ADJ	ON	2014/02/07 06:19
S100	2417	(119/263 or 210/150,167.21).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/07 06:28
S101	6	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S100	US-PGPUB; USPAT; USOCR; FPRS;	ADJ	ON	2014/02/07 06:28

			EPO; JPO; DERWENT			
S102	2	("2008/0264843").URPN.	USPAT	ADJ	ON	2014/02/07 06:33
S103	6806	(119/263 or 210/150,151,745,532.2,167.21,220,167.21).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/07 06:38
S104	13	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S103	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:38
S105	9426	(119/263 or 210/150,151,745,532.2,167.21,220,167.21 or 134/56R or 435/286.6 or 417/5 or 261/26).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/02/07 06:40
S106	13	(anode or cathode or electrode) same (((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S105	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:41
S107	301	(((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S105	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:41
S108	12	(((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S97	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:45
S109	1	(anode or cathode or electrode) and(((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S97	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:48
S110	42	(anode or cathode or electrode) and(((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S105	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/02/07 06:49
S111	9866	(119/263 or 210/150,151,745,532.2,167.21,220,167.21 or 134/56R or 435/286.6 or 417/5 or 261/26).ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	OR	ON	2014/09/08 08:30
S112	46	(anode or cathode or electrode) and(((micro or nano) same (bubbl$3)) or (micro$bubbl$3 or nano$bubbl$3)) and S111	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/09/08 08:30
S113	10	(anode or cathode or electrode) and(((micro and nano) same (bubbl$3)) or (micro$bubbl$3 and nano$bubbl$3)) and S111	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/09/08 08:46
S114	411	(anode or cathode or electrode) and(((micro and nano) same (bubbl$3)) or (micro$bubbl$3 and nano$bubbl$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	ADJ	ON	2014/09/08 08:47

9/8/2014 11:55:43 AM
C:\Users\callen\Documents\EAST\Workspaces\13247241.wsp

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13247241	SENKIW, JAMES ANDREW
	Examiner	Art Unit
	CAMERON J ALLEN	1774

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner
C02F1/48	9/8/2014	CA
C02F1/00	9/8/2014	CA
C02F1/04	9/8/2014	CA

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
210	739,746,748.01,748.16,748.15,748.17,748.19,749,757	1/16/2013	CA
422	22,27,28,129,186,186.04,186.03,186.07,186.01,186.1,186.15,186.16,186.21,616,243,305,308	1/16/2013	CA
204	155,157.15,157.5,164,176,178,450,554,193,194,260,272,280,277,278.5,287,288,288.1,288.2,230.2	1/16/2013	CA
205	701	1/16/2013	CA
22	192,321.7,1	1/17/2013	CA
205	628,633,742,756,757	2/06/2014	CA
119	263	2/07/2014	CA
210	167.21	2/27/2014	CA

SEARCH NOTES		
Search Notes	Date	Examiner
Google Search	1/16/2013	CA
See East Search History	1/16/2013	CA
Primary Joseph Drodge (General Assistance)	1/16/2013	CA
Inventor Search	1/16/2013	CA
See Updated East Search History	8/28/2013	CA
See Updated East Search History	2/06/2014	CA
See Updated East Search History	9/8/2014	CA

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**
	See East Search	1/16/2013	CA
	See Updated East Search History	8/28/2013	CA
	See Updated East Search History	6/04/2014	CA
	See Updated East Search History	9/8/2014	CA

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Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	13/247,241
	Filing Date	September 28, 2011
	First Named Inventor	
	Group Art Unit	1774
	Examiner Name	Cameron Allen
Sheet 1 of 2	Attorney Docket No: 3406.005USR	

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	WO-0189997A2	11/29/2001	Vagnes, Magne	
	WO-03072507A1	9/4/2003	Snekiw, James Andrew	
	WO-9939561A1	8/12/1999	Mazzei, Angelo L	

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS

Examiner Initial *	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T 1

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Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	13/247,241
	Filing Date	September 28, 2011
	First Named Inventor	
	Group Art Unit	1774
	Examiner Name	Cameron Allen
Sheet 2 of 2	Attorney Docket No: 3406.005USR	

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS		
Examiner Initial *	**Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.**	**T 1**
	"Effect of Oxygenated Water on the Growth & Biomass Development of Seedless Cucumbers and Tomato Seedlings under Greenhouse Conditions", Project Report: Seair Diffusion Systems, [Online]. Retrieved from the Internet: <URL: http://www.seair.ca/Pages/pdfs/DrMirzaReport.pdf>, (2003), 5 pgs	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.A./

EXAMINER /Cameron Allen/ **DATE CONSIDERED** 12/15/2014

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant is to place a check mark here if English language Translation is attached

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MINNEAPOLIS, MN 55402

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Melissa Cuff	(Depositor's name)
/Melissa Cuff/	(Signature)
01-13-15	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/247,241	09/28/2011	James Andrew Senkiw	3406.005USR	1737

TITLE OF INVENTION: FLOW-THROUGH OXYGENATOR

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0	$0	$480	02/18/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
ALLEN, CAMERON J	1774	210-748010

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☒ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 Schwegman Lundberg
2 & Woessner, P.A.
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Oxygenator Water Technologies, Inc.
(B) RESIDENCE: (CITY and STATE OR COUNTRY): St.Louis Park, Minnesota

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☒ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☒ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 19-0743 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ Applicant certifying micro entity status. See 37 CFR 1.29
NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
☐ Applicant asserting small entity status. See 37 CFR 1.27
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
☐ Applicant changing to regular undiscounted fee status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Albin J. Nelson/ Date January 13, 2015
Typed or printed name Albin J. Nelson Registration No. 28,650

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

JA1297

OWT Ex. 2118
Tennant Company v. OWT
IPR2021-00625

S/N 13/247,241 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	James Andrew Senkiw	Examiner: Cameron Allen	
Serial No.:	13/247,241	Group Art Unit: 1774	
Filed:	September 28, 2011	Docket No.: 3406.005USR	
Customer No.: 21186		Confirmation No.: 1737	
Title:	FLOW-THROUGH OXYGENATOR Re-issue of U.S. Patent No. 7,670,495		

COMMUNICATION RE: FEE ADDRESS

Mail Stop Issue Fee
Commissioner for Patents
P.O.Box 1450
Alexandria, VA 22313-1450

In response to the Notice of Allowance and Issue Fee Due, please record the Fee Address under the provisions of 37 CFR 1.363 as the following:

Customer Number 21186

Please direct any inquiries to the undersigned attorney at (612) 373-6939.

Respectfully submitted,

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 373-6939

Date January 13, 2015 By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

Electronic Patent Application Fee Transmittal	
Application Number:	13247241
Filing Date:	28-Sep-2011
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Filer:	Mark Victor Muller/Melissa Cuff
Attorney Docket Number:	3406.005USR
Filed as Small Entity	

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	2501	1	480	480

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**480**

Electronic Acknowledgement Receipt	
EFS ID:	21195334
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Mark Victor Muller/Melissa Cuff
Filer Authorized By:	Mark Victor Muller
Attorney Docket Number:	3406.005USR
Receipt Date:	13-JAN-2015
Filing Date:	28-SEP-2011
Time Stamp:	14:25:36
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$480
RAM confirmation Number	579
Deposit Account	190743
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406005USRsignesIFEE.pdf	309759 182eff53a1f3996c1d57d51c22ec257e2ca7c219	yes	3

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Transmittal Letter	1	1
Issue Fee Payment (PTO-85B)	2	2
Miscellaneous Incoming Letter	3	3

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30593 35053182c6ac7e413d921bbc6b53bbfd8ec3e447	no	2

Warnings:

Information:

Total Files Size (in bytes):	340352

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): James Andrew Senkiw
Title: FLOW-THROUGH OXYGENATOR Re-issue of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	February 18, 2015
Examiner:	Cameron Allen	Group Art Unit:	1774
Customer No.:	21186	Confirmation No.:	1737

Notice of Allowance Date: November 18, 2014

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following:

X Issue Fee Transmittal (Form PTOL-85).
X Communication Re: Fee Address (1 page).
X Authorization to charge Deposit 19-0743 in the amount of $480.00 to cover the Small Entity Issue Fee Payment.

Please charge any additional required fees or credit overpayment to Deposit Account No. 19-0743.

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being filed using the USPTO's electronic filing system EFS-Web, and is addressed to: Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 13th day of January, 2015.

Melissa Cuff
Name

/Melissa Cuff/
Signature

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor: James Andrew Senkiw
Title: FLOW-THROUGH OXYGENATOR / Re-issue of U.S. Patent No. 7,670,495

Docket No.:	3406.005USR	Serial No.:	13/247,241
Filed:	September 28, 2011	Due Date:	N/A
Examiner:	Cameron Allen	Group Art Unit:	1774
Customer No.:	21186	Confirmation No.:	1737

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Communication Associated With Allowance and Payment of Base Issue Fee (1 pg.)

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743. If applicable, any papers or fees supplied herewith are considered to be timely filed pursuant to 37 C.F.R. § 1.7(a), the response period falling on a Federal Holiday, Saturday or Sunday being extended to the next succeeding business day.

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
Customer No.: 21186

By: /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

S/N 13/247,241 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Examiner: Cameron Allen

Serial No.:	13/247,241	Group Art Unit: 1774	
Filed:	September 28, 2011	Docket No.: 3406.005USR	
Customer No.:	21186	Confirmation No.: 1737	
Title:	FLOW-THROUGH OXYGENATOR / Re-issue of U.S. Patent No. 7,670,495		

COMMUNICATION ASSOCIATED WITH ALLOWANCE AND PAYMENT OF BASE ISSUE FEE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant and Assignee re-affirm the statements made in their response of May 13, 2014 in this reissue application that they have reserved the right to submit one or more reissue continuation applications to address the subject matter that was cancelled in that response. This subject matter includes but is not limited to the apparatus, device, emitter, system and suspension described in the original patent. Applicant stated in his original invent3or's declaration for broadening reissue that he had a right to claim this subject matter but did not do so. To this end, Applicant and Assignee confirm that they will file a reissue continuation application and include a preliminary amendment directed to an electrolysis system.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402--0938
(612) 373-6939

Date January 14, 2015

By /Albin J. Nelson/
Albin J. Nelson
Reg. No. 28,650

Electronic Acknowledgement Receipt	
EFS ID:	21206997
Application Number:	13247241
International Application Number:	
Confirmation Number:	1737
Title of Invention:	FLOW-THROUGH OXYGENATOR
First Named Inventor/Applicant Name:	James Andrew Senkiw
Customer Number:	21186
Filer:	Janet Elaine Embretson/Tara McMillen
Filer Authorized By:	Janet Elaine Embretson
Attorney Docket Number:	3406.005USR
Receipt Date:	14-JAN-2015
Filing Date:	28-SEP-2011
Time Stamp:	14:27:13
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		3406005USR-Communication.pdf	161147 20534df0149eb42bff16ed66c091ea6e2231db0f	yes	2

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Miscellaneous Incoming Letter	2	2
Warnings:			
Information:			
	Total Files Size (in bytes):	161147	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Modified form PTO/SB/08A(04-07) OMB 651-0031
US Patent & Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** (Use as many sheets as necessary)	*Complete if Known*	
	Application Number	13/247,241
	Filing Date	September 28, 2011
	First Named Inventor	
	Group Art Unit	1774
	Examiner Name	Cameron Allen
Sheet 1 of 2	Attorney Docket No: 3406.005USR	

US PATENT DOCUMENTS

Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document
	US-20020074237A1	6/20/2002	Takesako, Kiyoyuki, et al.
	US-20030164306A1	9/4/2003	Senkiw, James Andrew
	US-20040118701A1	6/24/2004	Senkiw, James Andrew
	US-20060150491A1	7/13/2006	Senkiw, James Andrew
	US-20080202995A1	8/28/2008	Senkiw, James Andrew
	US-4,071,447	1/31/1978	Ramirez, Ernest R
	US-4,225,401	9/30/1980	Divisek, Jiri, et al.
	US-4,252,856	2/24/1981	Sara, Raymond V
	US-4,257,352	3/24/1981	Habegger, William
Change(s) applied to document, /D.H.P./ 1/14/2015	US-4,587,001	~~3/6/1986~~	Cairns, John F, et al. May 6, 1986
	US-5,015,354	5/14/1991	Nishiki, Yoshinori, et al.
	US-5,148,772	9/22/1992	Kirschbaum, Robert N
	US-5,534,143	7/9/1996	Portier, Ralph J, et al.
	US-5,982,609	11/9/1999	Evans, D. A.
	US-6,171,469	1/9/2001	Hough, G. S, et al.
	US-6,315,886	11/13/2001	Zappi, Guillermo Daniel, et al.
	US-6,328,875	12/11/2001	Zappi, Guillermo Daniel, et al.
	US-6,394,429	~~3/26/2002~~	Ganan-Calvo, Alfonso May 28, 2002
	US-6,524,475	2/25/2003	Herrington, Rodney E, et al.
	US-6,689,262	2/10/2004	Senkiw, James Andrew
	US-7,396,441	7/8/2008	Senkiw, James Andrew

FOREIGN PATENT DOCUMENTS

Examiner Initial *	Foreign Document Number	Publication Date	Name of Patentee or Applicant of cited Document	T1
	EP-0723936A2	7/31/1996	Sano, Yoichi	
	GB-1522188A	8/23/1978		
	WO-0189997A2	11/29/2001	Vagnes, Magne	
	WO-03072507A1	9/4/2003	Snekiw, James Andrew	
	WO-9939561A1	8/12/1999	Mazzei, Angelo L	

OTHER DOCUMENTS – NON PATENT LITERATURE DOCUMENTS

Examiner Initial *	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T1

EXAMINER **DATE CONSIDERED**

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant is to place a check mark here if English language Translation is attached

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.A./

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/247,241	03/17/2015	RE45415	3406.005USR	1737

21186 7590 02/25/2015

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Extension or Adjustment under 35 U.S.C. 154 (b)

A reissue patent is for "the unexpired part of the term of the original patent." See 35 U.S.C. 251. Accordingly, the above-identified reissue application is not eligible for Patent Term Extension or Adjustment under 35 U.S.C. 154(b).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

James Andrew Senkiw, Minneapolise, MN;

IR103 (Rev. 10/09)

PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
Stylesheet Version v1.2

EPAS ID: PAT3803298

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	LIEN

CONVEYING PARTY DATA

Name	Execution Date
OXYGENATOR WATER TECHNOLOGIES, INC.	03/13/2016

RECEIVING PARTY DATA

Name:	SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
Street Address:	1600 TCF TOWER
Internal Address:	121 SOUTH 8TH STREET
City:	MINNEAPOLIS
State/Country:	MINNESOTA
Postal Code:	55402

PROPERTY NUMBERS Total: 4

Property Type	Number
Application Number:	12023431
Application Number:	14601340
Application Number:	13247241
Application Number:	13657311

CORRESPONDENCE DATA

Fax Number: (612)642-8407

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: 612-672-8200
Email: debra.dix@maslon.com
Correspondent Name: AMY SWEDBERG
Address Line 1: 90 SOUTH 7TH STREET STE 3300
Address Line 2: MASLON LLP
Address Line 4: MINNEAPOLIS, MINNESOTA 55402

ATTORNEY DOCKET NUMBER:	2010-0164
NAME OF SUBMITTER:	STEVEN W. LUNDBERG
SIGNATURE:	/Steven W. Lundberg/
DATE SIGNED:	03/28/2016
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 2
source=OWT Lien#page1.tif
source=Oxygenator - Ex. A list of patents#page1.tif

NOTICE OF ATTORNEYS' LIEN IN PATENTS

NOTICE IS HEREBY GIVEN that the law firm of Schwegman, Lundberg & Woessner, P.A. ("Law Firm"), with its principal place of business at 1600 TCF Tower, 121 South Eighth Street, Minneapolis, Minnesota, duly authorized to practice as such in the State of Minnesota, claims and holds a lien in and to all of the patents listed on Exhibit A, and all of the applications and registrations associated therewith, together with all proceeds thereof, of Oxygenator Water Technologies, Inc., a Minnesota corporation ("Client"), with its registered address at 1660 S Hwy 100 #598, St Louis Park, MN 55416. Said lien is claimed for legal services rendered by Law Firm to Client for representation of Client in proceedings involving and affecting the ownership and title to the property upon which this lien is claimed for the reasonable and agreed upon value of $257,609.80 of which the sum of $43,977.30 remains unpaid.

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.

Steven W. Lundberg
Shareholder

STATE OF MINNESOTA)
) ss.
COUNTY OF HENNEPIN)

On this 23rd day of March, 2016, before me personally came Steven W. Lundberg, who being duly sworn did depose and say that he is a shareholder of the Law Firm described in and which executed the foregoing instrument.

THERESA A. HATHAWAY
NOTARY PUBLIC - MINNESOTA
My Commission Expires
January 31, 2018

Theresa A. Hathaway
NOTARY PUBLIC

Exhibit A

SLW FILE NUMBER	MATTER TYPE	TITLE	COUNTRY	APPLICATION FILING DATE	APPLICATION NUMBER	STATUS	ISSUE DATE	PATENT NUMBER	PRIORITY DATE	PUBLICATION NUMBER	INVENTORS
3406.002US1	Utility - DIV	FLOW-THROUGH OXYGEN	United States of America	Jan 31, 2008	12/023,431	Issued	Mar 2, 2010	7,670,495	Feb 22, 2002	US 2008-0179259 A1	James Andrew Senkiw
3406.005US2	Utility - REIS	FLOW-THROUGH OXYGEN	United States of America	Jan 21, 2015	14/601,340	Transferred			Sep 28, 2011		James Andrew Senkiw
3406.005USR	Utility - REIS	FLOW-THROUGH OXYGEN	United States of America	Sep 28, 2011	13/247,241	Issued	Mar 17, 2015	RE45,415			James Andrew Senkiw
3406.006US1	Utility - NPREG	ENHANCED RESIN REGEN	United States of America	Oct 22, 2012	13/657,311	Pending			Oct 24, 2011	US-2013-0098819-A1	Mark Rolfes

PTO/AIA/SO (09-14)
Approved for use through 10/31/2016. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

REISSUE PATENT APPLICATION TRANSMITTAL

Address to:

Mail Stop Reissue
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Attorney Docket No.	3406.005US3
First Named Inventor	James Andrew Senkiw
Original Patent Number	7,670,495
Original Patent Issue Date (Month/Day/Year)	3/2/2010
Express Mail Label No.	n/a

APPLICATION FOR REISSUE OF: *(Check applicable box)* [✓] Utility Patent [ ] Design Patent [ ] Plant Patent

APPLICATION ELEMENTS (37 CFR 1.173)

1. [✓] **Fee Transmittal Form** (PTO/SB/56)
2. [✓] **Applicant asserts small entity status.** See 37 CFR 1.27
3. [ ] **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. [✓] **Specification and Claims** in double column copy of patent format *(amended, if appropriate)*
5. [✓] **Drawing(s)** *(proposed amendments, if appropriate)*
6. [✓] **Reissue Oath/Declaration or Substitute Statement** (37 CFR 1.175) (PTO/AIA/05, 06, or 07)
7. [✓] **Application Data Sheet** NOTE: Benefit claims under 37 CFR 1.78 and foreign priority claims under 37 CFR 1.55 MUST be set forth in an Application Data Sheet (ADS).
8. [✓] **Original U.S. Patent currently assigned?** [✓] Yes [ ] No *(If Yes, check applicable box(es))*
   - [✓] Written Consent of all Assignees (PTO/AIA/53)
   - [✓] 37 CFR 3.73(c) Statement (PTO/AIA/96)
9. [ ] **CD-ROM or CD-R** in duplicate, Computer Program *(Appendix)* or large table
   - [ ] Landscape Table on CD
10. **Nucleotide and/or Amino Acid Sequence Submission** *(if applicable, items a. – c. are required)*
    - a. [ ] Computer Readable Form (CRF)
    - b. [ ] Specification Sequence Listing on:
      - i. [ ] CD-ROM (2 copies) or CD-R (2 copies); **or**
      - ii. [ ] Paper
    - c. [ ] Statements verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

11. [✓] **Statement of status and support for all changes to the claims.** See 37 CFR 1.173(c).
12. [✓] **Power of Attorney**
13. [ ] **Information Disclosure Statement (IDS)** PTOSB/08 or PTO-1449
    - [ ] Copies of citations attached
14. [ ] **English translation of Reissue Oath/Declaration** *(if applicable)*
15. [ ] **Return Receipt Postcard** (MPEP § 503) (Should be specifically itemized)
16. [✓] **Preliminary Amendment** (37 CFR 1.173; MPEP § 1453)
17. [✓] **Other:** - Reissue Application Fee Transmittal Form
    - Statement of Right of Assignee to Act pursuant to 37 CFR Section 3.73(c)
    - Copy of Patent Assignment Details from the USPTO Assignment on the Web

[✓] This is a continuation reissue or divisional reissue application *(i.e., a second or subsequent reissue application for the same issued patent). (Check box if applicable.)*

18. CORRESPONDENCE ADDRESS

[✓] The address associated with Customer Number: 38846 **OR** [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone			
Email					

Signature	/Philip Caspers/	Date	3-30-2016
Name (Print/Type)	Philip P. Caspers	Registration No.	33,227

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/SB/56 (03-13)
Approved for use through 08/31/2013. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

REISSUE APPLICATION FEE TRANSMITTAL FORM

Docket Number (Optional): 3406.005US3

Application as Filed – Part 1

	(1) Claims in Patent	(2) Claims Filed in Reissue Application	(3) Number Extra	Micro Entity Rate ($)	Micro Entity Fee ($)	Small Entity Rate ($)	Small Entity Fee ($)	Undiscounted Rate ($)	Undiscounted Fee ($)
Total Claims (37 CFR 1.16(i))	(A) 12	(B) 57	* 37 =	x =		x 40 =	1480	x =	
Ind. Claims (37 CFR 1.16(h))	(C) 2	(D) 5	** 2 =	x =		x 210 =	420	x =	
Application Size Fee (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $400 ($200 for small entity, $100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).								
	Filing Fee (37 CFR 1.16(e))						140.00		
	Search Fee (37 CFR 1.16(n))						300.00		
	Examination Fee (37 CFR 1.16(r))						1980.00		
	Total Filing Fee						3420.00		

Application as Amended – Part 2

	(1) Claims Remaining After Amendment	(2) Highest Number Previously Paid For	(3) Extra Claims Present	Micro Entity Rate ($)	Micro Entity Fee ($)	Small Entity Rate ($)	Small Entity Fee ($)	Undiscounted Rate ($)	Undiscounted Fee ($)
Total Claims (37 CFR 1.16(i))	*** -	****	=	x =		x =		x =	
Ind. Claims (37 CFR 1.16(h))	*** -	*****	=	x =		x =		x =	
Application Size Fee (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $400 ($200 for small entity, $100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).								
			Total Additional Fee						

* Enter (B) – 20, or enter "0" if (B) is less than 20.
** Enter (D) – minus 3, or enter "0" if (D) is less than 3.
*** After any cancellation of claims.
**** If the "Highest Number of Total Claims Previously Paid For" is less than 20, enter "20" in this space.
***** If the "Highest Number of Independent Claims Previously Paid For" is less than 3, enter "3" in this space.

- [x] Applicant asserts small entity status. See 37 CFR 1.27.
- [ ] Applicant certifies micro entity status. See 37 CFR 1.29.
  Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.
- [x] The Director is hereby authorized to charge any additional fees under 37 CFR 1.16 or 1.17 which may be required, or credit any overpayment to Deposit Account No. 502880.
- [ ] A check in the amount of $ _____ to cover the filing/additional fee is enclosed.
- [x] Payment made via EFS-Web.
- [ ] Payment by credit card. Form PTO-2038 is attached. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

/Philip Caspers/ — Signature
03/30/2016 — Date
Philip P. Caspers — Typed or Printed Name
33,227 — Registration Number, if applicable
612 436-9617 — Telephone Number

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

CONTINUATION REISSUE PATENT

Applicant(s)	James Andrew Senkiw	Consent by Assignee of Entire Ownership Interest to File a Second Continuation Reissue Application of U.S. Patent No. 7,670,495 pursuant to 37 C.F.R. §1.172
Serial No.	Unknown	
Filing Date	Filed Herewith	
Continuation Reissue of U.S. Patent No.	7,670,495	
Issued:	March 2, 2010	
Examiner Name	Unknown	
Group Art Unit	Unknown	
Attorney Docket No.	3406.005US3	
Customer Number:	38846	
Confirmation No.	Unknown	
Title:	FLOW-THROUGH OXYGENATOR	

Mail Stop Reissue
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I, Mark Rolfes, declare that:

1. I am the President of Oxygenator Water Technologies, Inc. D/B/A Water D.O.G. Works identified on recorded assignment document reel and frame number 026079/0823 of the Patent Assignment, Abstract of Title recordation department of the U.S. Patent and Trademark Office as holding all right, title and interest to U.S. Patent No. 7,670,495 subject to the security interest held by Jeffrey P. Brinks as recorded at assignment document reel and frame number 026079/0823.

2. I state that Oxygenator Water Technologies, Inc. D/B/A Water D.O.G. Works received its assignment of all right title and interest according to the chain of title transfer from the inventor, Mr. James Andrew Sekiw to Aqua Innovations, Inc. and hence from Aqua Innovations, Inc. to Oxygenator Water Technologies, Inc. as shown by the assignment documents recorded respectively at reel and frame numbers 020546/0241 and 021354/0676 of the Patent Assignment, Abstract of Title recordation department of the U.S. Patent and Trademark Office.

3. As President and officer of Oxygenator Water Technologies, Inc., I have caused Oxygenator Water Technologies, Inc., to request herewith a continuation reissue application of a prior continuation reissue application (Serial No. 14/601,340) which

in turn is a continuation reissue of an original broadening reissue application (application Serial No. 13/247,241, now U.S. Patent No. RE45,415) which original reissue application was made relative to U.S. Patent No. 7,670,495.

4. Pursuant to 37 C.F.R. §1.172 and as an Assignee of all right, title, and interest in and to U.S. Patent No. 7,670,495, subject to the security interest to Jeffrey P. Brink, I state on behalf of Oxygenator Water Technologies, Inc. that Oxygenator Water Technologies, Inc. consents to the filing of the broadening continuation reissue application submitted herewith which is a continuation reissue application of reissue application Serial No. 14/601,340 which in turn is a continuation reissue application of reissue application Serial No. 13/247,241 which in turn is a reissue application of U.S. Patent No. 7,670,495 and to the enlargement of the claimed subject matter as presented by the preliminary amendment filed herewith.

5. I further declare that all statements made herein of my own knowledge are true and that all statements make on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

6. Further Declarant sayeth not.

Mark Rolfes
President, Oxygenator Water Technologies, Inc.
Declarant

03/15/2016
Date